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A LESSON OF DISASTER.

The terrible disaster in the tunnel under the St. Clair River at Port Huron, to which we briefly referred last week, is another example of the niggardly policy of railroads that persistently risk the lives of their employes and patrons by neglect of proper safety precautions. The latest ghastly occurence cannot properly be called an accident, since the wilful maintenance of deadly risks removes the resulting disaster from the category of chance happenings. The St. Clair tunnel has long been known as dangerous and already has claimed a considerable list of victims. It is not far from a mile in length and has its lowest point deep under the river bed, so that a train once stalled can only be rescued at imminent peril of life from the constantly increasing volume of deadly gases. The evil thing of last week has occurred before and very possibly will occur again before the awful lesson penetrates the pachydermatous consciences of some railway magnates. Perhaps the next time it will be a passenger train that is stalled with a hundred or two victims slowly suffocated, that the railway company may still longer shun expense. And the bitterest thought about it all is the fact that the brutal indifference of those responsible probably cannot be reached by process of law. That is a drawback of corporate management—that criminal negligence in administration shuffles out of sight in the intricate division of responsibility, and justice cannot be meted out to it. We believe heartly in law and order, but if Lynch, J., is ever justified in calling his court of last resort into session, it is for the punishment of just such crimes against mankind as are otherwise unreachable.

To make the matter worse we understand that those who are guilty now have finally been scourged by public opinion, or by fear of the hereafter, into tardily, a year or more ago, opening negotiations for the electric locomotives that would have saved the lives lost last week. A few beggarly thousands stood between cupidity and safety, with the result that we now see. For some years past electric traction has been a well-tested success for just this work; there has not been the least doubt that electric locomotives are admirably suited for haulage under the conditions found in tunnels. And here the haul was not a long one, and a change of motive power was plainly the only way out of danger. From an engineering standpoint the task was not a serious one, and the necessary equipment could have been procured promptly from any one of several makers at any time within the last half dozen years. It has been shown by the experience at Baltimore that in the long run the extra expense of electric haulage through the tunnel is far from serious, but to certain callous and penurious souls dollars are precious and human life is cheap, and if safety costs anything it is better to take the risk. We wonder if any one of the rulers of the road ever ventured his precious carcass in that St. Clair tunnel by the side of one of his freight engineers? Morally, the authors of this latest tragedy stand on just the same plane as the dive-keeper who thriftily puts wood alcohol in his whisky, knowing that it is poisonous, but trusting that none of his customers will get enough of it to kill him. The condition of things in that tunnel was not unique, it was simply a little worse than is usual in tunnels. Very few of the longer ones are so ventilated that the accidental stalling of a train would be unlikely to cause loss of life. A long tunnel has about the general proportions of a capillary tube and it requires enormous ingenuity to keep it clear even of a dangerous amount of coal gas, for the carbon monoxide always present is highly poisonous.

The only safe means of working a tunnel is by electric locomotives. The Baltimore tunnel when first put in operation used steam locomotives and there were almost immediate casualties. But in that case the management was alive to its moral responsibilities and proceeded without delay to change its motive power, even though at that time heavy electric haulage was in its early experimental stage. Since then it has been merely necessary to follow that precedent, duplicating the equipment with the addition of the improvements which have from time to time been introduced. There is nothing experimental about the business, and persistence in the use of steam simply means that the management wilfully takes the chance of killing employes and passengers rather than to go to the expense of putting in an electrical equipment. We believe the day is coming when no railroad will be permitted to operate through tunnels in any other way than by electricity. There may be legitimate difference of opinion about the economy of electric haulage on trunk lines, but this is not a question of economy but of public safety. The car stove has been forced out in spite of protests against the difficulty of a change. The link coupler once universally used on freight trains has been pushed into the background, although not yet entirely suppressed, and other menaces to life must follow it. We are so mortally afraid in this country of over-governing that there is continual failure in making and enforcing the most salutary regulations. Last year the railroads of the United States killed less than a score short of ten thousand human beings, and injured nearly eight times as many. Some of these casualties may perhaps be fairly classed as unpreventable, being due to causes which no reasonable foresight could have guarded against, but it would probably be well within bounds to say that ninety per cent. of them are clearly due to negligence of some sort which in the nature of things are preventable. The records of foreign roads bear out this statement, for while it chanced that last year on the British lines was remarkable in the almost total absence of injuries to passengers, the ordinary experience there indicates that railway casualties can by proper care be kept down to small figures. It is the business of our lawmakers to see to it that proper care is enforced here.

POWER STATIONS AND RAILWAYS.

Two very notable papers on the larger applications of electricity marked the sessions of the Engineering Congress recently held at St. Louis. The writers were Stillwell and White and their topics supplemented each other in a very remarkable fashion. The former took up the generation and transmission of electrical power and the latter its utilization in general railway service. Both are distinguished for breadth of view rather than for minute study of detail, and both are documents of permanent value in setting forth the state of the art of this particular epoch. Such papers are of large importance in putting into correct perspective the intricate particulars of a tangled subject. It is hard to pick out especial portions as worthy of comment when the value of the work lies in judicial generalization. We cannot refrain, however, from calling attention to Mr. Stillwell's discussion of the problems of dynamo efficiency and regulation as affecting the choice between direct-current and alternating-current apparatus. The course of improvement is clearly marked out, especially in relation to the heating efficiency and regulation of large machines, and in carrying the subject into power station design Mr. Stillwell takes a singularly sane and conservative view of the use of turbo-generators. He shows plainly the advantage in first cost that is likely to come with increasing use of turbines, and steadily refuses to get excited over the possibility of saving in space which, however valuable it may be on shipboard, is apt to be exaggerated in its relation to power station design. There is a point beyond which compactness ceases to be a virtue, and that point is sometimes nearly approached if not fairly reached. Saving in space even in city stations does not have a large bearing on operating expense, and in the last resort it is fuel economy that is generally the determining factor, since in large stations fuel is by far the largest item of cost.

Mr. J. G. White's paper on electricity as a substitute for steam as a motive power is marked by a most interesting array of data on increase of traffic and a very sound view of the advantages of electric traction in its general relation. He is disposed to lay far less stress than many engineers on economy of power and far more upon economy in upkeep and the incidental sources of gain generally neglected. Mr. White is a firm believer in the direct-current system as already developed and goes somewhat out of his way to criticise the three-phase railway systems used somewhat on the continent, in spite of the fact that they have no competitive existence in America as yet. Here he displays a certain degree of unfamiliarity with the art, perhaps not surprising in view of his very wide experience with the direct-current apparatus exclusively used on cars in this country. It is most emphatically not true broadly that three-phase motors are either less efficient or heavier for their output than direct-current motors. On the contrary, while for special purposes either type may be developed in some particular direction, it is entirely feasible to build three-phase motors for railway or any other purposes at least as light and efficient as direct-current motors. In railway working the greatest fault of the three-phase type is its tendency to constant speed. From the standpoint of a street railway specialist like Mr. White, this is a well-nigh fatal objection, and added to the double trolley wire, puts three-phase work quite out of consideration. In point of fact, lack of efficiency and unusual weight may very probably be charged against the single-phase motors, but the advantages of variable speed and easy speed variation they certainly have.

On these very points Mr. Stillwell in the discussion took issue with Mr. White and having made a rather careful investigation of the Valtellina system he retains the advantage as to the argument of the facts. We do not, however, quite agree with Mr. Stillwell as to the practical importance of the various schemes for returning energy to the line, as forming a material advantage of three-phase working. Frankly, we doubt whether the game is generally going to be worth the candle, and in the rare cases where it might be worth, while it is perhaps doubtful whether a nearly constant-speed type of motor would be otherwise desirable. Mr. Leonard's locomotive with motor-generator meets the requirement of returning energy to the line better than any alternating motor, whatever may be its other properties. And by the way, this locomotive does not involve anything like the extreme weight predicted by Mr. White on account of the high speed practicable in the motor-generator part of the equipment. Mr. Stillwell takes generally a more cheerful view of the possibilities of electric trunk line service than does Mr. White, whose conservative adherence to the so-called "standard practice" of the present rather interferes with his longer vision. It is assuredly true that much nonsense has been talked regarding the abolition of the steam locomotive, which with all its faults is still a very wonderful machine. On the other hand, electric traction with high-voltage alternating current carried clear up to the locomotive is a proposition not at all on the same plane as an attempt to extend our present interurban service with its long chain of costly contingencies between the prime-mover and the cars. At the present moment there are few trunk lines in this country with density of traffic enough to give electric traction its characteristic advantages. It may well be that the best chance for immediate trunk line work will be found on British or Continental systems. Given, however,

the development of apparatus along the directions now made evident and trunk line service will become very much simpler than it now appears.

Resonance in Wireless Telegraph Circuits.

Although the fundamental phenomena of wireless telegraph electrostatic and electromagnetic circuits are already fairly well understood, yet an enormous amount of experimental and mathematical work must yet be done before all the details of these wonderful operations are elucidated to a like degree. It is known, for example, that any vertical antenna of simple geometrical form has a natural fundamental period of oscillation, and that the stock of energy which it can naturally possess is necessarily very limited. This stock varies with the capacity of the vertical, and with the square of the initial oscillation voltage. The capacity is so small that the energy stored in the antenna and available for radiation is comparatively small, even at the highest effective voltages. Consequently, an adjunct capacity, or auxiliary condenser, becomes necessary, connected with the sending antenna. But the extra capacity and stock of electrical energy thus added may be useless, or even worse than useless, if the natural period of oscillation of the condenser is not in agreement with the natural period of oscillation of the antenna. If, however, the antenna and the condenser can be tuned together then the antenna is enabled to oscillate with a persistence that would have been impossible without the aid of the auxiliary condenser.

Effective radiation then requires a well-defined natural period of oscillation for the antenna and also the selfsame well-defined period for the auxiliary condenser. Either component of the dual vibrator so formed may be tuned to consonance with the other, by the adjustment of added inductance or capacity. Such adjustments have, however, to be made with great care, since points of discontinuity and reflection may be formed, giving rise to secondary reflected waves and dissipation of energy. All experiments upon the subject are valuable, and particularly when they are accompanied by actual measurements. The ordinary observations of a merely qualitative character are of relatively little technological value. It is the quantitative relations that lead to engineering applications. In the last number of the *Physical Review* is a paper by D. G. W. Pierce upon "Some Experiments in Wireless Telegraph Circuits." In these experiments the two little antennæ were seven meters high and twenty-five meters apart, so that not even the megaphone was necessary to communicate messages between them. The receiving instrument, however, was a particular form of the Fleming alternating-current galvanometer, the indications of which were quantitatively comparable. The sending apparatus consisted of an alternating-current transformer, working through a Cooper Hewitt interrupter. The sending and receiving circuits were connected with their respective vertical antennæ by air-cored induction coils. The inductances throughout each series of observations were kept constant and the capacity only was varied in the sending and receiving circuits. When the sending circuit condenser was altered, the receiving circuit condenser had likewise to be adjusted in order to secure the maximum scale reading on the transmission of a signal. The observations under unchanged conditions repeated themselves with considerable regularity, the probable error of a single observation working out in fact in one series at about one per cent.

The period of the sending circuit, i. e., of the sending condenser and its associated series inductance, was varied between about half a microsecond and three microseconds, by changing the capacity of the sending condenser. The capacity of the receiving condenser was in each case varied through a considerable range and the corresponding received current strength observed. It was found that when the period of the receiving circuit was adjusted in this way to equality with that of the sending circuit, there was a resonant rise of received current. This resonant rise, however, reached a maximum for the particular case when the period of both circuits was 2.66 microseconds. Above and below this critical period the resonant rise fell off. It was, therefore, inferred that at this adjustment not only were the receiving and sending circuits in tune, but also that they were both in tune with the antennæ. The difference in galvanometer deflection between the tuned period of 2.66 and 2.80 microseconds in the auxiliary circuits was nearly five to one, representing a current strength ratio of 2.2. From the resonance curve of the deflection at the best period of 2.66 microseconds (frequency 376,000) the apparent resistance of the receiving circuit appeared to be 9 ohms, although the resistance to steady currents was only 1.4 ohm. This is a good instance of the effect of high frequency in increasing the dissipative resistance of a circuit.

When the secondary coils connected with the antennæ were shortened from 240 to 115 turns, reducing their inductances about four times, the corresponding series of observations gave a maximum resonance at 1.27 microseconds. The falling off in the resonance was considerably more marked in this case, a change in tune of a given percentage effecting a more marked diminution in the resonance than when the antennæ were loaded with the four-fold heavier inductance. This result seems to be in conformity with the generally accepted proposition that an unloaded antenna is very selective in its tuning, a small variation in frequency being sufficient to upset the consonance almost entirely. On the other hand, a heavily loaded antenna is less delicate in its selection and is more tolerant of departure from the strictly consonant frequency of excitation.

A curious condition developed during the research in regard to the effectiveness of the mercury vapor interrupter employed. This seems to have been markedly affected in its work by temperature. The resonant rise of galvanometer deflection in the receiver circuit was about three times greater when the interrupter was kept at an external temperature near boiling water, than when that temperature was 33° C. above or below. The best temperature of the oil bath containing the interrupter is shown to have been 95° C. It would seem that the interruption of the current by the mercury vapor interrupter was more sudden and sharp at 95° C. than at temperatures within 40° C. above or below. It is possible, however, that other effects, such as the resistance of the interrupter, before breaking, may have affected the result. Another interesting result brought out by the resonance observations is that, although the resonant rise is a maximum when the local circuits are tuned to the fundamental frequency of the antennæ, yet a considerable rise was noticed at the triple frequency of the antennæ, namely at or near 1,128,000 cycles per second, corresponding to a period of 0.887 microsecond, the maximum deflection at this harmonic being 42 per cent. of that at the fundamental, or the inferred current strength at the harmonic being about two-thirds of that at the fundamental. On the other hand, however, the deflection at the double frequency was only 23 per cent., or the current strength 48 per cent. Why the resonance at the octave should be so much less than the resonance at the trebled frequency overtone is not clear, since a free wire ought to have no preference for odd or even harmonics. The measurements appear, therefore, to indicate that when an antennæ is connected to an oscillating system it can be excited to resonance most powerfully when its pitch is equal to that of the auxiliary system. A lesser degree of resonance may, however, be evoked when the auxiliary system strikes an overtone of the antenna. It seems, in fact, that some degree of resonance may be produced whenever the frequencies of the two components are not prime to each other.

The St. Louis Convention of American Street Railway Association.

The twenty-third annual convention of the American Street Railway Association at St. Louis was one of the largest in the history of the association, the registered attendance exceeding 1,100.

The following officers were elected for the ensuing year: President, W. Caryl Ely (re-elected); first vice-president, Elwin C. Foster (re-elected); second vice-president, John I. Beggs; third vice-president, Richard McCulloch; secretary and treasurer, T. C. Penington; executive committee, the president, the vice-presidents and John J. Stanley, Howard F. Grant, C. G. Goodrich, Frank G. Jones and W. E. Harrington. The secretary's report presented at the convention showed that on September 20, 1904, the membership was 196. The expenses during the fiscal year ending September 20 were $9,559.18, and the balance on hand that date was $7,646.56.

One of the important matters considered by the convention was means for a closer connection between the association and its affiliated bodies, the American Street Railway Mechanical and Electrical Association and the Street Railway Accountants' Association of America. It was suggested that to this end changes should be made in the constitution of the association, increasing the size of its executive committee in order to accommodate as members these affiliated organizations. The matter was finally placed with a committee for report at the next meeting of the association.

Upon motion of Mr. H. H. Vreeland, the president of the association was authorized to appoint a special committee of nine members, three of whom may be representatives of the technical press, whose duty it shall be to endeavor to increase the membership of the association. Mr. Vreeland pointed out that at the present time somewhat more than 600 independent street railway companies were operating in the territory covered by the association, of which only 196 were members of the association.

Mr. Vreeland also offered a motion, which was adopted, authorizing the executive committee to employ such clerical or expert assistance as may seem desirable for the consideration of questions coming before it.

A resolution was also adopted recommending that during the coming year arrangements be made so that at the next annual convention the duties of the secretary of the association shall be enlarged so as to require that he give his entire time to the work of the association, and that the secretary shall be qualified by training and experience to collect and preserve information on technical subjects and other matters of general interest to the members of the association, that his office may constitute a bureau of information on subjects of importance to the work of the association.

The first session of the convention, which was held on Wednesday, October 12, was opened by an address by President Francis, of the World's Fair. He referred to the great success at the Exposition of the intramural railway, which carries an average of 55,000 persons per day, or quite 50 per cent. of the paid admittance to the grounds. He spoke in high terms of the great efficiency of the two great electric railway systems of St. Louis, which, in the present trying period, are gaining the good will, not only of the people of the city, but of the hundreds of thousands of strangers who visit the Fair. He said that the total cost of the Exposition represents an expenditure of over $45,000,000. He believed it would be a long time before another universal exposition is held in this country, and that in the future expositions would more likely be confined to special industries.

President Ely, in response to President Francis' address, said that he considered it a mistake to keep the Exposition closed on Sunday, which, moreover, would lead to a loss of fully $1,000,000. He paid a high tribute to President Francis for his organizing and executive ability and said that to him personally no small part of the credit is due for the success of the grandest of all expositions.

Prof. Goldsborough followed with an address in which he pointed out the features of the Exposition of special interest to street railway men. Mayor Rollo Wells then welcomed the convention, after which President Ely delivered his presidential address.

In this was reviewed the important work in the electric railway field during the past year, principally with respect to heavy traffic, and an account was given in some detail of the New York Subway system. A considerable portion of the address was devoted to the subject of the reorganization of the association. There have grown up alongside of it two subsidiary organizations and it had been proposed to create a third having for its membership electric roadbed engineers and superintendents. President Ely thought that this cannot go on indefinitely, for with a large number of organizations, each pursuing its solitary way unmindful of the others, there would finally be chaos. He therefore considered it vitally necessary at the present time to take up the matter of the reorganization of the association, and suggested that this should be left to a committee on which the several affiliated bodies would have a representative. He referred to the excellent results that had come from separating the matter of exhibits from the work of the association and confining it to the Manufacturers' Association, which will take entire charge of the annual exhibit.

At the meeting on Thursday several technical papers were read, two of which—on steam turbines—were abstracted in our issue of last week. One of these was presented by Mr. R. H. Rice and the other by Mr. J. R. Bibbins and gave rise to considerable discussion. In reply to a query Mr. Rice said that the commutators of the Curtis turbine run dry, lubricating carbon brushes being used, and that the commutator bars are secured by nickel-steel rings shrunk on over insulation. Mr. C. O. Mailloux gave the result of some observations on steam turbines which he had made in a recent tour in Europe. There he had seen numerous instances of direct-current dynamos driven by turbines running at from 2,500 to 4,000 r.p.m. The brushes used are generally of carbon, although in some cases metal brushes are employed, the latter requiring, however, a better electrical design. In a few cases where sparking had occurred this was due to unbalancing, the chattering of the armature being sufficient to keep the brushes vibrating on the commutator. In reply to a query Mr. Mailloux said that he had never heard of any cases where there had been trouble from the presence of water in the steam. He spoke of one installation where a 250-kw turbine was using exhaust steam from a 1,500-hp reciprocating engine, the turbine running condensing, and no trouble had been experienced.

Mr. S. M. Hopkins, of Columbus, Ohio, said that in Columbus there is a 500-kw turbine connected at the end of a steam line, and while stating there would be a large amount of water condensed in the pipe, sufficient to make it almost impossible to start a small exciter engine on the same line, no difficulty was experienced in starting the turbine. In some comparative tests made between two 500-kw turbines and two tandem reciprocating engines, it was found that the latter showed a higher efficiency. He considered, however, that the turbine outfit is the superior generating unit. In experiments with superheat it was found that superheating was of even greater value to engines than to turbines. Mr. Hopkins thought that superheat cost practically as much as could be got in economy from its use. Mr. W. H. Abbott, of Cleveland, said that his company is operating two 1,500-kw turbines with 50 to 100° superheat; at times, however, water is present in fairly large quantities in the steam pipe. Mr. Hopkins added that he had found that they get water in engines almost as badly with superheated steam as with saturated steam. Mr. Mailloux said that this was due to water entrained mechanically and advised the use of separators. He referred to the fact that turbine manufacturers themselves do not claim that the steam turbine has the highest economy under all conditions, being more efficient at lower pressures than at higher pressures. A very prominent English engineer has proposed using the reciprocating engine on higher pressures, say from 200, expanding down to 10 to 15 pounds above the atmosphere, and using the turbine with condensation for the latter pressures. He referred to a Swiss reciprocating steam engine in Berlin, a 5,000-hp, triple-expansion, with four cylinders, which, running at very nearly full load, has developed a horse-power-hour for something less than 9 pounds of water with superheat up to 600° F. or more; but this engine has 16 valves and complicated mechanism and requires a great deal of lubrication. As the steam turbine is more developed it will approximate more nearly the results obtained by the reciprocating steam engine. He said that there is a certain critical price for coal at which the steam turbine is not preferable to the reciprocating engine, that there is a price slightly higher at which the steam turbine fell short in comparison with the gas engine, and at a little higher price, of the Diesel engine. He considered it the first duty of a consulting engineer when called upon to advise a client to investigate the cost of fuel.

Mr. Bibbins, after reading his paper, said in answer to a query, that the steam turbine without being made extra large or bulky, can take charge of the very highest vacuum, whereas the reciprocating engine cannot do so. He referred to the desirability of excluding air, to obtain the highest vacuum.

A French Municipal Electrical Plant.

THE municipal electrical plant of the city of Lyons, France, is the largest installation of its type in Europe, the ultimate capacity being 22,000 hp. The head of the canal supplying water to the turbines is near the town of Jouage, the power house being located between this point and the city of Lyons. The available head varies from 33 to 40 ft., though during extremely high water it drops to 26 ft., owing to the rise of water in the tail-race. The canal is 11.6 miles long, 10 miles of which is the head water canal and 1.6 miles the tail-race. Owing to the natural slope of the ground it was necessary to build a wall on only one side of the head canal, but the tail canal had to be excavated, the dirt thus obtained being used in building the wall of the head canal. The canal is from 196 to 344 ft. wide and the least depth is 8.2 ft. Between the fifth and seventh miles the canal widens into a natural depositing basin which has an area of 370 acres.

Near the entrance to this basin an overflow is provided which serves to maintain the water level constant. The canal is used for furnishing water for irrigating purposes and as a means of transportation as well as for the power plant. For the purposes of handling transportation a lock 524 ft. long and 52 ft. wide is provided near the power house, but up to the present time the traffic through the canal has been small.

The building of the canal was attended with considerable difficulty as the bed was found to be far from water tight and the fills were gradually washed away. The bed of the canal also became soft and marshy and it was necessary to line it with concrete for a considerable distance above the power plant. Owing to these difficulties the completion of the plant was greatly delayed and the cost reached $9,000,000, the canal and turbine building costing $4,400,000, the turbines, dynamos, motors and distribution system $2,000,000, and the necessary land and right of way $1,200,000.

The present equipment consists of eight turbines of 1,250 hp each, three of 250 hp and two of 1,500 hp each. Six additional turbines of 1,500 hp each are in process of erection. The power house is 525 ft. long and 50 ft. wide, inside dimensions. The canal is led back of the power house, each turbine being provided with a special tube leading to the turbine chamber, the entering water being controlled by a cylindrical hooded valve 9.9 ft. in diameter, which is controlled from the interior of the plant. The portion of the canal at the power house is built of solid concrete and masonry. The upper part of the building is of brick and the roof is of steel construction with a monitor running the entire length of the building, thus providing ample light and ventilation.

The turbines are of the vertical type and are located on the lowest floor level, the revolving part of the generator being directly connected to the vertical extension of the turbine shaft on the level of the power house floor. The regulators, bearings and the oil pumps are located on an intermediate stage between the turbines and the generators. Each turbine is placed in a separate enclosed chamber and is readily accessible. The chambers of the 1,250-hp turbines are of cast iron.

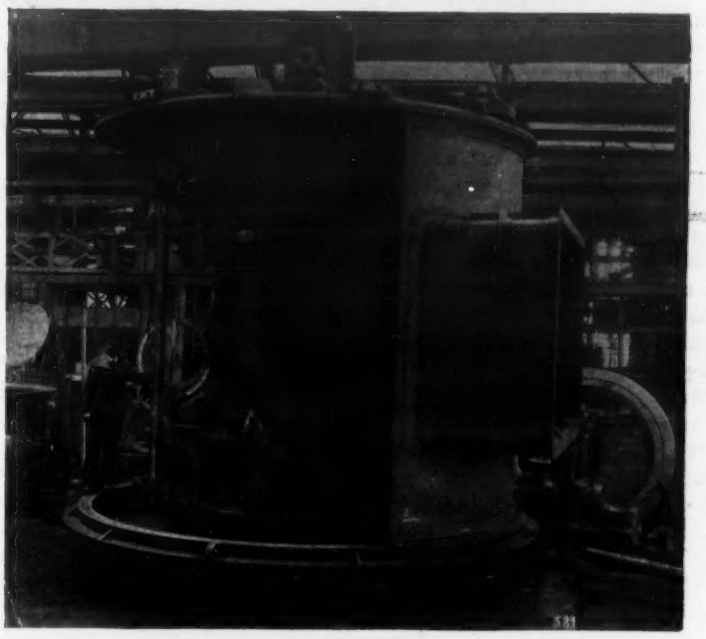


FIG. 2.—1,500-HP TURBINE WITH CASING REMOVED.

FIG. 1.—INTERIOR OF POWER HOUSE, SHOWING 1,250-HP TURBINES AND EXCITERS.

The turbine revolving part is conical in shape and revolves at a speed of 1,200 r.p.m. Each turbine has three divisions, the highest of which is used at times of very high water, this being kept closed by the regulating mechanism at other times. The operation of the divisions is controlled by collars which fit around the circumference of the turbine body, and are movable in a vertical plane by means of rods. The two lower collars are balanced so that the upward

movement of one causes the downward movement of the other, and thus the regulating mechanism is relieved of the weight of the shaft and collars. The servo-motor of the regulator is provided with a differential piston, the smaller part of which is constantly under oil pressure; the larger piston is also under oil, its pressure being controlled by a fly-ball governor. After operation the piston is returned to its middle position by hand. The oil for the servo-motor is furnished by a pump, one operated from each turbine. Above the turbine wheel is a relief piston mounted on the shaft and arranged with a special packing to prevent leakage of the water. Above this piston is a chamber connected by a pipe to the draught tube, so that the water that does leak through the packing is discharged.

The total weight of the revolving part of the machine is 42.6 tons, and by the use of this piston 22 tons of the weight is balanced by the water pressure, the remaining 20.63 tons being carried by a ring bearing having a surface of 115 sq. in. With this comparatively small load it is unnecessary to provide oil under pressure. The bearings are surrounded by a chamber filled with oil. The oil enters through holes drilled at an angle to the vertical plane and circulates through slots in the bearing and seat. These slots are so arranged as to insure an efficient circulation of the oil. The excess oil is recirculated through the bearings. The 250-hp turbines are used for driving the exciters and are of the same construction as the turbine described above.

The latest 1,500-hp power turbines are constructed on radically different lines from the machine already described. It is of the double turbine type, which is capable of developing a higher efficiency under the conditions prevailing at this plant, as it has been

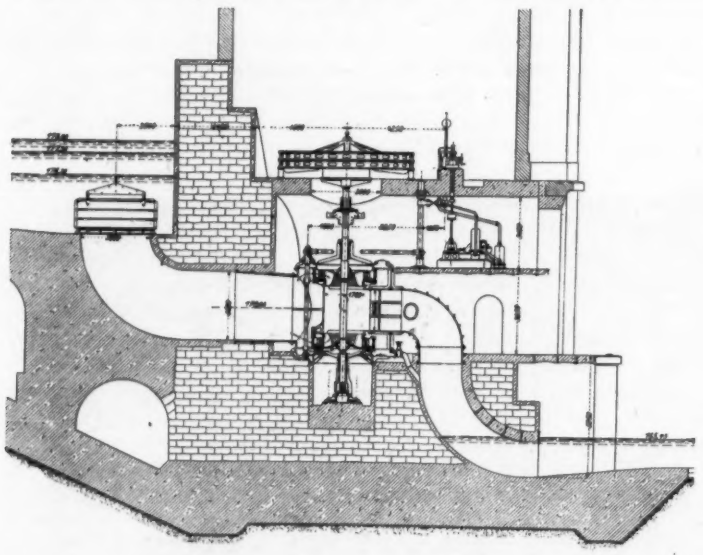


FIG. 3.—SECTION THROUGH 1,500-HP TURBINE SETTING.

discovered that the variation in the available head and the frequency of such variation is considerably greater than had at first been expected. Both turbine wheels are connected to a common discharge chamber from which leads a draft tube built partly of cast iron and partly of wrought iron, which terminates in a concrete pipe leading to the tail-race.

The section of the draft tube is gradually increased toward the tail-race in order to avoid shocks from the discharged water. In this turbine both the intake and the discharge are at the side, while in the 1,250-hp turbine the intake is at the side and the discharge at the bottom underneath the turbine. The bearing of this turbine is above the turbine chamber, while in the 1,500-hp machine the shaft runs entirely through the turbine and the bearing is underneath the chamber. The type of bearing is the same in both cases.

In the larger turbines there are two water wheels mounted on the shaft, the water being admitted underneath as well as above the lower wheel, so that the weight of the parts is partially balanced and the pressure of the water is relieved. The upper disc is drilled so as to counteract the effect of the suction in the draft tube. Both turbine wheels are regulated by butterfly regulators, which are operated by means of oil pressure from the servo-motor as previously described. The turbine casing is of steel, while the upper and lower parts are of cast iron. The dynamo shaft is rigidly coupled to the turbine shaft, the regulating mechanisms being belt-connected to a pulley which forms a part of the coupling on the shaft of the turbine.

The dynamos are three-phase machines running at 120 r.p.m. and furnishing current at 3,500 volts. The three machines for furnishing the exciting current are located between the alternators in front of the generator switchboard. These machines are direct-connected each to the vertical shaft of a 250-hp turbine and revolve at a speed of 250 r.p.m.

The generator switchboard contains 19 panels, the three center ones carrying the measuring instruments for the generators and exciters and the eight panels on either side being for the generators. The switchboard, which is located in a raised gallery, has a steel frame with white marble panels. The switching room is located in an extension of the building in the rear of the board. On a horizontal table in front of the switchboard are the rheostat hand wheels for controlling the exciter current. In the rear of the building is located the feeder switchboard. The entire power house is lighted by arc lamps. The turbines were built and furnished by Escher, Wyss & Co., of Zurich, and the dynamos and other electrical machinery by Brown, Boveri & Cie., of Baden, Switzerland. The plant was built by the Société des Forces Motrices du Rhone.

The Development of Power at Niagara.

The following from the columns of the *Wall Street Journal* presents a somewhat pessimistic consideration of the economic conditions underlying the water power development of Niagara Falls:

"The five Niagara power companies already in operation, or with power plants under construction, have already spent $26,500,000 on their installations. Only two companies are now actually producing power and even these have not yet attained an output equal to their full capacity of 155,000 hp, the actual output being about 115,000 electrical hp. This is used 85,000 electrical hp locally and 30,000 electrical hp in Buffalo, the Tonawandas and Lockport. The following table shows for the five power companies the quantity of water which they may utilize hydraulically for the generation of electrical energy, the present power capacity, actual output, and amount of money already spent in real estate or power plants:

Company.	Wat. Rts. H.P.	Act. Cap. H.P.	Act. Out. H.P.	Capital. Inv. to Date.
American side of river—				
Niagara Falls Power	200,000	105,000	75,000	$15,000,000
N. F. Hyd. P. & Mfg.	100,000	50,000	40,000	5,000,000
Canadian side of river—				
Toronto-Niag. Power	125,000	.....	.....	1,500,000
Canadian-Niag. Co.	100,000	.....	.....	3,500,000
Ontario Power Co.	225,000	.....	.....	1,500,000
Total	750.000	155,000	115,000	$26,500,000

"No further increase in output is contemplated immediately by the American companies. The Canadian-Niagara will have half its plant completed with an output of 50,000 electrical hp by January 1, 1905. The Ontario Power Company, in which the Westinghouse Electric & Manufacturing Company is said to be quite largely interested, is working on a first section of its plant with a capacity of 35,000 hp, while the Toronto-Niagara Company's installation is for the full 125,000 hp. Neither of these companies, however, will be in a position to sell power for probably a year at least.

"Within a few months the capacity of the power plant, 205,000 electrical hp, will be for sale in a market that is already quite fully supplied and when the other companies enter the field as producers the capacity will be 415,000 hp.

"As recently as two years ago, the power actually in use for all purposes within 300 miles of Niagara was estimated at only 225,000 hp. This figure included 20,000 electrical hp in use at Hamilton, Ontario, developed from Decew's Falls and power in use in places to which the cost of a transmission line would preclude the use of Niagara power. If the companies are able to transmit power successfully and at commercial rates over 300 miles distance, there will still be a large surplus to dispose of. Ultimately they may induce factories that use power extensively to locate at Niagara."

Telephones in Cincinnati.

The Common Pleas Court in Cincinnati has reversed the action of the Probate Court in giving grants and franchises to independent telephone companies, several of which have been trying to enter the local field and compete with the Bell interests.

Three-Wire Distribution.

By F. HARDIE JEANNIN.

ALTHOUGH direct currents for both lighting and power will, in the course of time, be relegated to a shelf in the mouldy past, where many things now curious are finding a well-earned rest, yet since this time has not fully come, a notice of the art touching certain continuous-current systems will not be out of season. Even if strictly direct-current methods are becoming the exception rather than the rule, there is still necessity for the direct current in connection with alternating current, of which it may be considered as a function.

The first prominent step forward in electrical engineering was perhaps that made by Mr. Edison when he brought out the three-

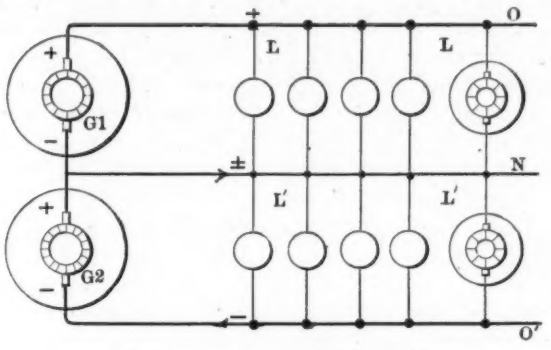


FIG. 1.—TWO-MACHINE METHOD.

wire system of distribution, which is a logical sequence to the multiple-series system. The first method developed by Mr. Edison for obtaining a neutral wire with respect to two outside wires, or outers, was the two-dynamo method. This method consisted in two similar direct-current generators connected in series, with a neutral taken off from the common connection between the two machines, the load being equally divided between the outers and the neutral.

This method is shown by Fig. 1, where G_1 and G_2 are the two generators connected in series; O and O' are the outside leads; N is the neutral; L is the load connected between O and N; and L' is the load connected between N and O'. Suppose L' should become greater than L. Then G_2 will furnish the extra current required by the excess of L' over L, the current for this excess load going out over the neutral, N. If L were greater than L', then the extra current would be furnished by G_1 and the excess current would return by the neutral, N. Manifestly, the voltage on either side can be adjusted at will to compensate for line losses independently of the other generator. To-day this is the most satisfactory method, where circumstances permit its use. Of course, there are adjuncts and auxiliary devices brought out since intended to make the regulation automatic and provide safety and improve the service in general. But it is not the purpose of this article to go into detail concerning such points.*

As is always the case, one scheme suggests another. And the three-wire system soon was the subject of various modifications and improvements. Perhaps the most noteworthy modification is shown in Fig. 2. Here G is a generator furnishing the full voltage

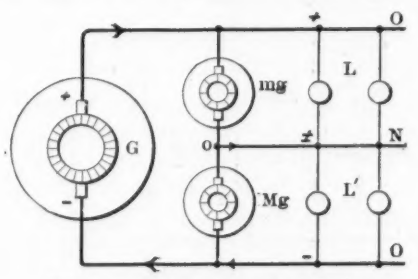


FIG. 2.—BALANCER SET METHOD.

of the outers to the two leads of a two-wire system. It is desired to take off a neutral without adding another generator similar to G. The solution is found in two smaller machines, $m\,g$ and Mg, in every way alike and secured to the same shaft. These two machines are connected together in series across the two outside leads of the two-wire system, and the neutral is taken off at the common connection, O, between the two machines. When the three-wire load is equally divided between the two outers, O and O', and the neutral, N, the two machines, $m\,g$ and Mg, will run as motors without load. Before pointing out the action of these two machines, which, taken together, are called a balancer set, it will be conducive to clearness to first see how the potential comes to be higher on one side than the other when the load is unbalanced.

The voltage across either outer and the neutral is directly proportional to the current and the resistance of the lamps, and inversely as the number of lamps in multiple. That is, $V = Ir/N$, where V is the voltage between the outer and neutral; I is the total current; r is the resistance of one lamp, and N is the number of lamps in that side. Consequently, if the number of lamps, L, decreases, the voltage across O and N will proportionately increase. If the current, I, could decrease in the same proportion, there would be no increase in the voltage. But the current cannot so decrease except the load, L', diminishes also in the same proportion, which is the condition of a balanced system, and the voltage is consequently in that case equal between O and N and O' and N. So then if L should diminish while L' remains unaltered, the full voltage across the outers would partly force the current required for the larger number of lamps, L', through the smaller number, L, resulting in a rise in voltage across O and N and a decrease in voltage across N and O'. Such a condition would soon result in the destruction of all the lamps on the lightly loaded side.

Manifestly, then, if the voltage rises the machine of the balancer set connected in that side will be increased in speed as a motor and the machine connected to the side of decreased voltage will give out current as a generator. That is, the one acting as a motor will drive the other acting as a generator, with the result that a part of the current required by the larger load will pass through the motor, at the same time supplying it with power; and the balance of the current required will pass through the load of the lightly-loaded side and come from the machine acting as a generator. It is obvious that the balancer set will furnish current for the excess of load of one side over the other, this excess current coming partly through the motored machine and partly from the machine acting as a generator. Therefore, the set will take care of an unbalanced load equal to their combined capacities. The two machines of the set divide the surplus current required by the overloaded side equally between them.

This method, like the first, permits an independent adjustment of the voltage on either side to suit the load conditions, and is conse-

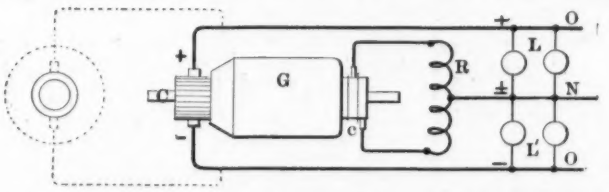


FIG. 3.—COMPENSATOR AND ROTARY BALANCER METHOD.

quently the most satisfactory method of obtaining a three-wire distribution where two generators cannot be installed to good advantage.

Another modification is shown in Fig. 3. The parts of the system are as follows: G is the generator supplying power to a two-wire system, O and O'; C is the commutator; c are the collector rings; R is a reactive coil; L is the load between O and N; L' is the load between N and O'; and N is the neutral. The distinctive feature of this system is the reactive coil, R, connected to the generator armature, G, by means of brushes resting upon the collector rings, c, the neutral being taken off from the center of the reactive coil, R, as shown. It is to be noted that this method requires the generator to have a special armature. It must be provided with the collector rings, c, which is disadvantageous in that no other machine can take its place in case of emergency unless likewise equipped with collector rings, thus requiring this machine to be in service continuously.

I have shown but two collector rings, while four are better and more usual. The current that passes through R from the generator is alternating, which consequently prevents the armature from being short-circuited; that is, R is inductive for such currents. But as it is not inductive for direct currents, the surplus current from the neutral, N, is in no way hindered from entering the armature. In

*For a description of safety devices, etc., see "Notes on Certain Three-Wire Systems," by Mr. C. T. Mosman in ELECTRICAL WORLD AND ENGINEER for Oct. 31, 1903.

the design of the reactive coils, *R*, care must be exercised that the direct current does not affect it magnetically; that is, the winding with respect to the continuous current must be differential. Failure to take this fact into consideration caused the first machine to be inoperative.

Another bad feature of this method is the lack of means for adjusting the voltage on either side to compensate for line losses with change in load; and owing to the internal losses of the apparatus the voltage is decreased rather than increased, as it should be on the heavily loaded side. In place of a reactive coil, *R*, it is evident that a transformer could be used, in which case we would have a single-phase rotary converter. But this will be taken up later. However, since *G* is virtually a rotary converter used as a generator, it can be used, not as a rotary from which a neutral is taken, but as a balancer. Rotary converters used as balancers can be relatively small and do not require a very large compensator owing to the fact that they can be operated at a comparatively high speed. They have the same disadvantage that the generator and compensator method has. That is, there is no inherent opportunity to compensate for resistance losses of the overloaded side. In order to consider *G* of Fig. 3 as a rotary balancer, it is only necessary to add the generator shown by the dotted lines.

Where compensators are used, a booster, *B*, Fig. 4, can be inserted in the neutral, in which case the potential of the booster will

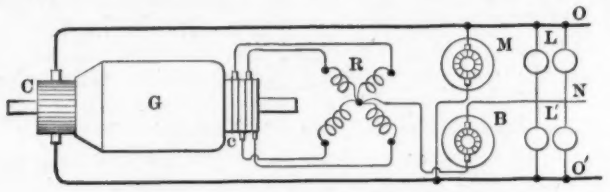


FIG. 4.—COMPENSATOR WITH BOOSTER.

cause a displacement of the neutral potential with respect to *O* and *O'*. The booster is operated by a motor, *M*, when *G* is a generator, or it may be secured to the rotary shaft when *G* is a rotary balancer. The booster voltage is always in the direction of the current in the neutral, and therefore in case of unbalancing it is added to one side and subtracted from the other consistently with the needs of the system under those conditions; consequently, the booster must be a series machine so that the potential will reverse with the reversal of the current in the neutral. Evidently the booster must be able to carry the full neutral current, and it will also be a very low-voltage machine. Therefore, it is apt to be expensive to make and is likely to prove troublesome in operation. While this is an improvement over the simple generator or rotary converter and compensator, yet it is not as flexible nor intrinsically equal to the two-generator or the two-machine balancer method.

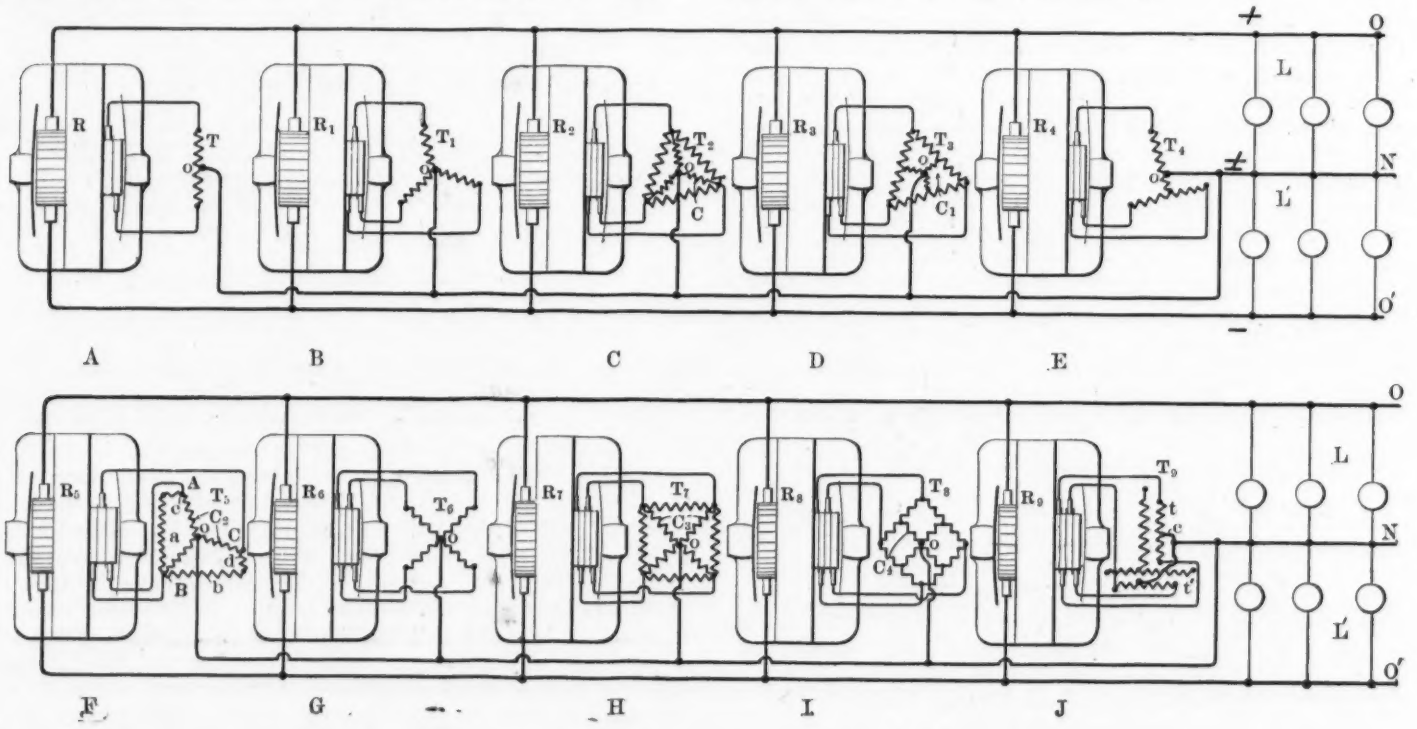
With the advent of the rotary converter it became desirable to take off from them a three-wire distribution from a single machine. This was to be done by finding a point of zero potential the same as with the methods already discussed. In Figs. 5 and 6 I have given a sort of galaxy of rotary converters from which is supplied a three-wire network. The first example, *A*, is for a single-phase rotary. *R* is the rotary and *T* is the secondary of the power transformer supplying the same with alternating currents. Neutral is, as shown for this case, taken off at the center of the transformer secondary winding.

The next case, *B*, is that of a three-phase rotary operated from a star-connected set of power transformers, T_1. In this case the neutral is taken off at the common connection, *O*, which is the point of zero potential of the system, and is consequently the point at which to introduce the current passing over the neutral.

It should be borne in mind that the action of the direct current on the iron must be considered. In the case of transformers connected so as to stop at the point of zero potential, as is the case with star-connected transformers, special care is required, i. e., the transformers will have the magnetizing current increased, due to the unbalanced direct current passing over the neutral. The permissible amount of unbalancing of the three-wire system must be ascertained for each case.

A three-phase delta-connected rotary is shown at *C*, where R^2 is the rotary converter; T_2 is the delta-connected set of power transformers, and *C* is a star-connected set of compensators or small transformers with the point of zero potential at the center, *O*, from which the neutral is taken off. By connecting the compensators or transformer coils, as the case may be, to the power transformers at their centers, as shown by *D*, they can be smaller, as shown by *C*. The auxiliary device, C_1, is, as before, star-connected, with the neutral connected at *o*.

The Scott connection is shown at *E*, where R_4 is the rotary; T_4 are the secondaries of the power transformers, the primaries being connected to a quarter-phase system; and *o* is the point of zero potential, from which the neutral is taken off. If the transformers, *B*, *C*, *D* and *E*, were superimposed with their terminals coinciding, the point *o* would be identical for them all.



FIGS. 5 AND 6.—ROTARY CONVERTER METHOD.

We now pass on to the cases of Fig. 6. The first instance, *F*, is a special case and is intended to show how an emergency may be met, and also to bring out the fact that almost an unlimited number of variations may be worked out. In this case R_5 is a three-phase rotary; T_5 is a specially arranged set of power transformers connected to a quarter-phase circuit; C_2 is a star-connected set of com-

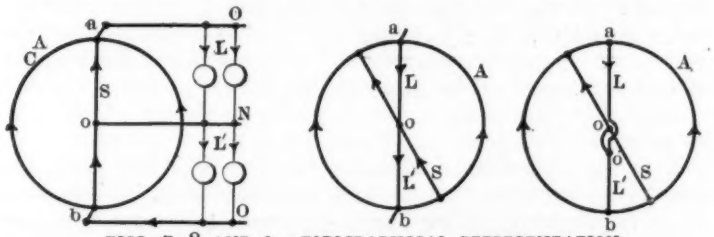
pensators, or the secondaries of suitable transformers; and *o* is the point of zero potential. As shown, *a* and *b* are the main transformers and *c* and *d* are two additional secondaries or separate transformers in phase with *b* and *a*, respectively. The taps for the rotary are taken off at *A*, *B* and *C*, to which points the compensators or auxiliary transformers are also attached. The most objectionable feature about such schemes for regular practice is the out-of-phase currents passing through the transformer windings.

In the case shown at G we have a quarter-phase rotary, R_6, operated from a quarter-phase system by means of the power transformers, T_6. Here it is only necessary to connect the two transformers together at their middle and from this point to take off the neutral. When the power transformers are connected up as shown at *H*, it will be necessary to utilize a set of compensators or small transformers, C_3. Or the compensators may be smaller and connected to the main transformers, as shown by *I*, provided there are taps from the middle of these transformer windings.

The example at *J* is the reverse of the case at *E* of Fig. 5; that is, the quarter-phase rotary, R_9, is operated from a three-phase system by means of a Scott transformer. This case is essentially the same as the case at *G*, the neutral being taken off at the same place.

It will be noted that all the methods of Figs. 5 and 6 have the same defect as has been already mentioned in connection with similar schemes. They do not provide a means of compensating for the losses of the line and the internal losses of the apparatus when the system is unbalanced.

It will perhaps be of interest to give at this juncture the topographical method of representing such systems as we have been considering. The case at *A* (Fig. 5) is thus shown by Fig. 7, where

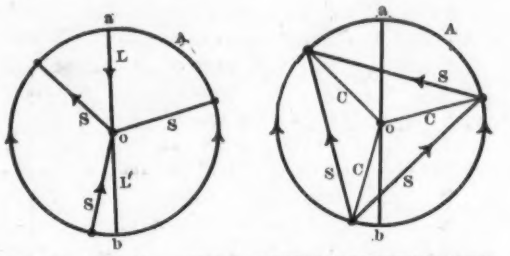


FIGS. 7, 8 AND 9.—TOPOGRAPHICAL REPRESENTATION.

A and *C* are the armature and commutator; *a* and *b* are the brushes; *S* is the secondary of the power transformer; *o* is the point of zero potential; and the other parts the same as before. Further simplification is possible. This is given by the diagram of Fig. 8, where *A* is the armature and commutator, incidentally; *a* and *b* are the brushes; *L* and *L'* are the load, or rather the voltage for the load on each side of the neutral; *S* is the power transformer, and *o* is the point of zero potential. Now this diagram is to one scale for all the different parts of the system, and gives consistent results for a complete analysis of the same. The arrowheads show the direction of the currents and voltages. Since the diagram is to scale as a property of the same, it is seen by inspection that the drop of potential from *a* to *o* must be the same as that from *o* to *b*. That is, the point *o* must be at the center of the circle and at the middle to *a b*. Also it is evident that the point *o* must be at the middle of *S*. Therefore, the point *o* for the circle *a b* and *S* must coincide.

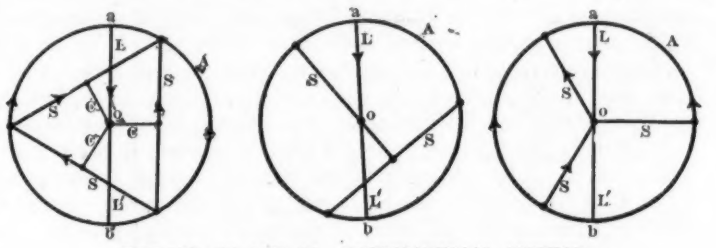
Suppose (Fig. 9) that *L* decreases while *L'* remains unaltered. Then the drop between *a* and *o* will tend to be greater than between *o* and *b*. This is shown by *o'*, the new position for the neutral potential, which gives *a o'* as the voltage for *L* and *o' b* for the voltage for *L'*. Such an unbalancing of voltage is prevented by *o* on *S*, being connected to *o'* on *a b*, with the result that the amount of voltage represented by *o o'* is subtracted from *a o'* and added to *o' b*. Consequently, the voltage on both sides of the system is kept equal. The cases for *B*, *C*, *D*, *E*, *F*, *G*, *H*, *I* and *J* are shown topographically by Figs. 10, 11, 12, 13, 14, 15, 16 and 17, respectively; *G* and *J* being the same and included in the diagram of Fig. 15. In revolving the diagram the direct-current voltage line, *a b*, remains vertical with its ends stationary at the brushes.

A very interesting application of the two-machine and compensator methods combined was recently made by the General Electric Company for a South African firm, and intended to furnish power for motors running shop tools and machinery. This novel scheme is illustrated by Fig. 18, where G_1 is a 50-volt generator in series with a 150-volt machine, G_2; *C* is the compensator used in connection with generator G_2, which is furnished with collector rings for that purpose; *O* and *O'* are the outers; *N* is the neutral for the two generators, and *N'* is the neutral for generator G_2, connecting to the compensator at *o*. This system is especially adapted to the operation of motors making frequent starts and stops and requiring to be frequently changed in speed, such as in fact obtains in shop work. The motor in being started is first connected across



FIGS. 10 AND 11.—TOPOGRAPHICAL REPRESENTATION.

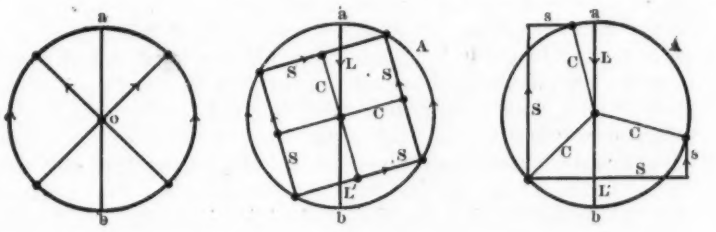
the 50-volt circuit, and then successively to the 75, 125, 150 and 200-volt circuits, the fields of the motors being permanently connected to the 200-volt circuit, thus permitting the use of standard ap-



FIGS. 12, 13 AND 14.—TOPOGRAPHICAL METHOD.

paratus. This method is susceptible of various modifications to meet different conditions.

Compensators may be introduced at any part of a system across



FIGS. 15, 16 AND 17.—TOPOGRAPHICAL REPRESENTATION.

any phase in order to obtain a neutral for a three-wire distribution. For instance, one or all of the compensators, *C*, may be introduced, as shown by Fig. 19, where *G*, *G* and *G* are are generator windings, either Y or delta-connected. Connecting the neutral to the center of the compensator is equivalent to connecting it to the zero point

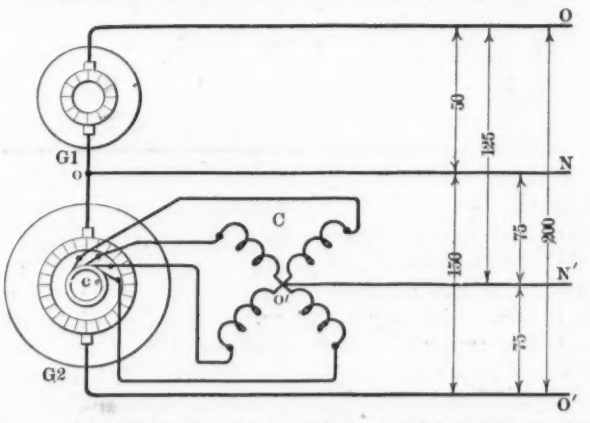


FIG. 18.—COMBINATION OF TWO-MACHINE AND COMPENSATOR METHOD.

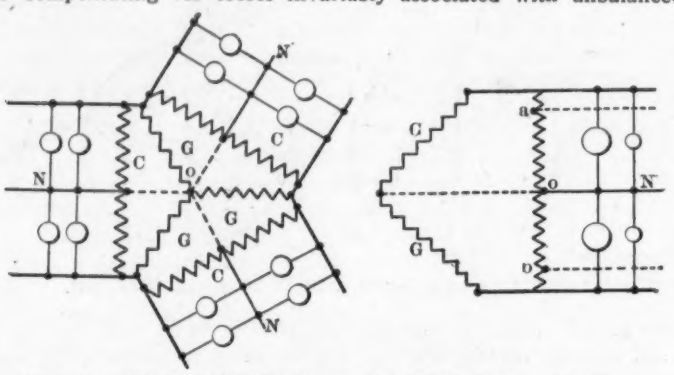
of potential of the system at the generator, as shown by the dotted lines.

In Fig. 20 is shown how a compensator can be placed across the two outside wires of a three-wire quarter-phase system. To avoid special voltage lamps the taps should be taken off from points *a* and *b* for the outers of the three-wire distribution.

Thus we see that as branches of a tree are the outgrowth from the trunk, so are these various methods the offshoots of one funda-

mental principle, and can be multiplied almost indefinitely, according to the ingenuity of the engineer.

A means which has occurred to me for boosting the heavier loaded side that may prove practical and efficient within required limits for compensating for losses invariably associated with unbalanced



FIGS. 19 AND 20.—TRANSFORMER AND COMPENSATOR METHOD.

conditions, is shown by Fig. 21. There are complexities connected with this arrangement that do not appear on the surface which will not be considered at this time with any degree of minuteness.

In order to avoid as much confusion as possible, a single-phase rotary converter will be supposed. In the figure, A is the armature; S is the power transformer; a and b are the brushes; R is a rectifier connected to S by sliding contacts through flexible connections, f and f, and making contact at p and q; c is the rectifier brush to which is connected the neutral, N; the other parts are the same as before. The contacts, p and q, always move simultaneously toward or away from the center, o.

The contacts, p and q, are controlled by a suitable controller connected in series with the neutral, N, and make contact with S as follows: When L' is greater than L, p and q move away from the center, o, with p moving toward a and q toward b. As L and L' become more nearly equal, p and q move toward o in the reverse order to that just stated. When L and L' are equal, p and q will be at o. Then if L should become greater than L', p and q will move away from o with p advancing toward b and q toward a, having passed each other at o. With p and q away from o, the rectifier voltage will be added to the side having the greater load and subtracted from the side having the lighter load. Thus it is apparent that the action of this rectifier method is similar to the booster method described in connection with Fig. 4.

By referring to the left-hand portion of Fig. 21, some of the general properties of this system may be noted. The lines l, m and

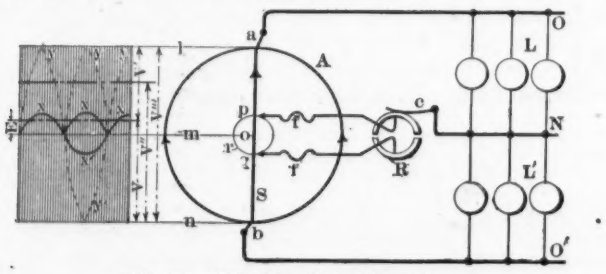


FIG. 21.—SCHEME FOR BOOSTING.

n drawn from a, o and b are parallel, and the shaded portion represents the continuous-current voltage for a certain interval of time. The distances between l, m and n are proportional to the voltage between the same. Discarding the rectifier for the moment, the line m is kept equidistant from l and n regardless of the condition of the load by reason of the neutral, N, being connected to S at o.

Now, if N be connected to S at some point off the center, o, as at p, there will be established an alternating current with a maximum value equal to $o\,p$, and which will float in the field of the direct-current voltage—that is, between the lines l and n—without in the least affecting the voltage across the outers, O and O'. By means of the circle, r, the curve $X\,X'\,X$ is drawn which represents this floating alternating current, and shows its relation to the voltage across the outers and to the neutral. When the rectifier is introduced, the portion of the curve below the line m is made to appear above the line giving the curve $X\,X\,X$. In this case the voltage between O and N is V'; between N and O' it is $\frac{V'''}{2} + E$, and between O and O' is V'''. When this condition obtains, the load, L' is greater than L, so that the displacement of the neutral voltage by the amount E compensates for the losses on the heavier loaded side.

Again discarding the rectifier for the present and connecting N to the end of S, which is the same thing as connecting it direct to the armature A, we get the curve of extreme condition, $y\,y'\,y$, which is with l, say, as a base line, similar to a commutator voltage curve. Rectifying this curve we obtain $y\,y\,y$, giving voltage V''' between N and O'. With N connected direct to A, the curve $y\,y'\,y$ does not show the displacement of N to one side with respect to O and O'. This is better shown by the diagram of Fig. 22, where it is to be seen that the point p' moves in the circle so that the curve $y\,y'\,y$ with respect to the lines l and n is a cosine function of $a\,p'$ and $b\,p'$;

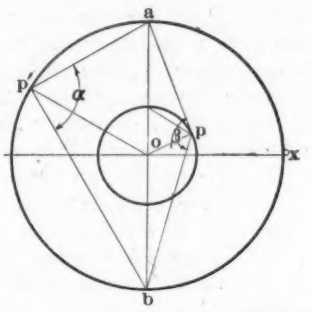


FIG. 22.—DIAGRAM OF BOOSTING SCHEME.

and since the angle, α, is always 90°, there is a pulsating current between O and N 90° apart in phase from a similar current with respect to N and O'. Consequently, there is a direct current between O and O', and a pulsating one between each outer and the neutral. After a fashion, therefore, a quarter-phase motor might be operated from this three-wire system, it having become a three-wire, quarter-phase system with regard to the neutral. This is of no practical value, however. When the rectifier is introduced this relation no longer exists, although there remains two pulsations differing in phase, but considerably modified. With N connected direct to the armature, the effective potential between both outers and the neutral is $.612V'''$ (which is also the voltage between adjacent collector rings of a three-phase rotary converter), so that special voltage lamps would be necessary. Boosting or compensating for line and internal losses would be absent. With the rectifier in use the point of contact for N for maximum practical requirements would be at a point on a smaller circle as at p, so that these disturbances would be so small as to be unnoticeable. For any circle less than the armature circle, the angle β is constantly changing. To see clearly the relation of voltages between the armature, the two outers and the neutral, let it be imagined that in Fig. 22 the outer, O, is a line passing through the paper at a and normal thereto, and that N and O', respectively, in the same manner pass through at p' and b. Then the neutral will follow the circle with p', and its voltage at any instant with respect to either O or O' will be that point projected on $a\,b$. With the rectifier introduced there must be another point diametrically opposite the point p; then these points will move in one of the semi-circles above or below x during the time they are connected to N through the rectifier segment.

It may perhaps be of interest to observe that if $p'\,a$ extended and $p'\,b$ extended were coils in which pulsating potentials were produced following the wave or curve $y\,y'\,y$, and making contact at a and b (Fig. 21) with p' moving uniformly with respect to absolute time, a continuous current could be obtained from the terminals a and b, although the armature be removed. Also, when the machine is a generator and the frequency is high enough to prevent flickering of the lights, if special voltage lamps be used the neutral, N, may be connected direct to the armature through one collector ring or brush, discarding the compensator as well as the other collector rings and brushes; but compensating for losses will be impossible.

The curve $y\,y'\,y$, it may be noted, is the curve of the square of the ordinates for an alternating current whose maximum value is $\sqrt{V'''}$, and whose effective value is $\sqrt{\frac{V'''}{2}}$. Consequently, with respect to l or n the line m is the average of the ordinates of the curve $y\,y'\,y$. It may also be said that the pulsating wave, $y\,y'\,y$, is equivalent to superimposing an alternating current having a maximum value equal to $o\,a$ upon the direct current, $o\,b$.

On the Theory of the Matthews and the Russell-Léonard Photometers for the Measurement of Mean Spherical and Mean Hemispherical Intensities.[1]

BY EDWARD P. HYDE.

THE following article contains a brief résumé of a theoretical investigation of the Matthews and the more recent Russell-Léonard integrating photometers. A detailed discussion will appear shortly in the second *Bulletin* of the Bureau of Standards.

Much attention has been given in the last few years to the development of photometers designed for the measurement of mean spherical and mean hemispherical intensities of light sources. Among other instruments of this type that have appeared may be mentioned particularly the two instruments[2] designed by Matthews, and the more recent instrument[3] of Léonard, based on theory first given by Russell[4]. In each of these instruments mirrors are used in order to project upon the photometer screen light emitted by the source at various inclinations to the vertical axis, but in each instrument a different method is used for weighting the light from each mirror, so that in the summation the light from each mirror shall be diminished in proportion to the area of the zone in which the mirror lies and for which it is supposed to give the mean value.

Thus, in the Matthews photometer for incandescent lamps the proper weighting is effected by the inclination of the light from each mirror on the screen, whereas in the Matthews instrument for arc lamps a smoked sectored disc cuts down the light from each mirror in proportion to the area of the zone in which the respective mirror lies. In the theory of each of the above instruments the surface of the unit sphere is divided into an integral number of zones of equal arc, and to each zone a mirror is assigned. If, instead of dividing the surface of the sphere into zones of equal arc, we divide it into zones of equal area, and in each zone place a mirror in such a position that it gives the mean value of the intensity for the zone in which it lies, the light from each mirror, since it stands in every case for a zone of the same area, is to be given the same weight in the summation for mean spherical intensity, and consequently no further weighting is necessary.

This principle is made use of in the instrument of Léonard, though it was Russell who first suggested that in the determination of mean spherical and mean hemispherical candle-power by a number of readings at intervals in the vertical plane, the readings be made, not at equal angular intervals, as is ordinarily done, but at intervals corresponding to the middle points of successive zones of equal area, so that the unweighted arithmetical mean of the various readings may be taken as the mean spherical intensity of the source.

It was the original intention of the investigation to obtain a more complete theory of the Matthews instruments, particularly of the instrument intended for incandescent lamps, as it was in connection with the design of such an instrument for the Bureau of Standards that this investigation was undertaken. Since, however, the same method of treatment can be employed in the theoretical study of the Russell-Léonard photometer, the investigation was extended to include that instrument also.

In the theoretical discussion of the Matthews Integrating Photometer for incandescent lamps as given by Prof. Matthews before the American Institute of Electrical Engineers, the assumption is implicity made that eleven pairs of mirrors placed every 15° (the two end pairs at 0° and 180° being omitted) will yield a value of mean spherical candle-power, which will agree with the true integral solution to within a negligibly small error. Earlier, in describing his integrating photometer for arc lights, Prof. Matthews makes a definite statement to this effect, and adduces as evidence values computed from the hypothetical intensity curve

$$I_\theta = I_o \sin \Theta.$$

Thus applying the two equations for mean spherical candle-power, the exact integral equation

$$I_{ms} = \frac{1}{2}\int_0^\pi I_\theta \sin \Theta \, d\, \Theta$$

and the approximate equation

$$I_{ms} = \frac{\pi}{2n}\sum_0^\pi I_\theta \sin \Theta$$

to the above intensity curve, he obtains in each case

$$I_{ms} = .785\, I_0$$

or, if $I_0 = 100$

$$I_{ms} = 78.5$$

As a result of this agreement between the integral and the summational values, the conclusion is drawn that a mirror every 15° is entirely sufficient to give an approximate value, which will differ from the true value by a negligibly small error. Now, although it is perfectly allowable to apply results obtained from a hypothetical intensity curve to actual intensity curves agreeing more or less closely with it, it cannot be assumed that because the integral and summational values agree quite closely for one form of intensity curve that the same agreement can be expected in the cases of intensity curves of different forms. In fact, as will be shown later, there is an error of over 2 per cent. entering when we apply the above summational expression to the intensity curve

$$I_\theta = I_o \cos \Theta$$

In the second place it is interesting to note that the hypothetical intensity curve which happened to be chosen in order to show that eleven mirrors are sufficient to give a summation very close to the integral value, will show equally well that any number of mirrors whatever, arranged at equal angular intervals beginning at $\Theta = 0°$ and ending at $\Theta = \pi$ will give absolutely the true result. This follows from the equation

$$\sum_{m=1}^{m=n} \sin^2 \frac{m\pi}{n} = \frac{n}{2}$$

which can be proven easily, m and n being integers.

Hence we see that if we should divide the sphere into but two zones, placing a single mirror-pair at $\Theta = 90°$, we would still obtain exactly the true integral value for an intensity curve of the form

$$I_\theta = I_o \sin \Theta,$$

so that no definite information with regard to the necessary number of mirrors can be obtained from the consideration of this intensity curve alone.

Since in the theory of the instrument the underlying assumption is that the illumination of the screen produced by each mirror is the mean illumination for the zone in which the mirror lies; or, in terms of the above equation, that the mirror has been placed in such a position in each zone that

$$I_\theta \sin \Theta$$

for each mirror shall exactly equal the integral

$$\int_{\theta_{m-1}}^{\theta_m} I_\theta \sin \Theta \, d\, \Theta$$

where Θm and Θm_{-1} are the limits of the zone, the problem for investigation is to determine the position of each mirror in its respective zone so that it will give exactly the mean value for that zone. Since, further, the position of each mirror will in general be different for every different form of intensity curve considered, it becomes necessary to select typical intensity curves covering all the more common distributions likely to be encountered in the photometry of incandescent lamps, and to determine the arrangement of mirrors most nearly satisfying all the cases to be considered.

Thus, choosing the three hypothetical intensity curves,

Case I.....$I_\theta = 1$
Case II.....$I_\theta = \sin \Theta$
Case III.....$I_\theta = \cos \Theta$

as typical of all incandescent lamp curves, the arrangement of mirrors exactly satisfying each case was first determined, supposing the surface of the sphere to be divided into 20 zones, as that was the number decided upon in the design of an instrument of this type for the Bureau of Standards. Then the arrangement of mirrors satisfying each case was tried in each of the other two cases in order to determine how closely it satisfies them. Finally, the two equiangular arrangements, for twenty zones, 0°, 9°, 18°, — — — — 180°

[1] Communication from the National Bureau of Standards.
[2] *Trans.* Amer. Inst. of Elec. Engrs., vol. xviii, p. 677; 1901. Vol. xx, p. 1465; 1902.
[3] *L'Eclairage Electrique*, vol. xl, p. 128; 1904.
[4] *Jour.* Inst. of Elec. Engrs., vol. xxxii, p. 631; 1903.

and 4½°, 13½°, 22½°, — — — — 175½° were tried in each case in order to determine which of the five arrangements of mirrors satisfies all the cases most completely. The equiangular arrangement 0°, 9°, — — — — 180° is similar to the arrangement Matthews uses (0°, 15°, 30°, — — — — 180°), and has the disadvantage of restricting the use of the instrument to mean spherical determinations. If an attempt is made to use it for mean hemispherical measurements by covering half the mirrors, the difficulty of the mirror at 90° is encountered. If this mirror is included, too much weight is given to the horizontal zone. If the mirror is excluded, too little weight is given. In either case since the horizontal zone is very important on account of its area, such large errors are introduced as to prohibit the use of the instrument for mean hemispherical determinations.

The results of this investigation are contained in Tables I and II. In Table I are given the five different arrangements of 20 mirrors that were tried in the above three cases of hypothetical intensity curves, and in Table II are given the results of applying each of these arrangements to each of the three cases. Thus in columns I and II of Table I are given the two equiangular distributions. In columns III, V and VII are given the angular distributions of mirrors satisfying Cases I, II and III, and in columns IV, VI and VIII are given the angles through which the mirrors must be shifted from the middle points of the arcs in order to give the true results for Cases I, II and III, respectively. Values of angles in the quadrant $\Theta = 90°$ to $\Theta = 180°$ are merely the supplements of those given in the table, and, hence, are omitted.

In Table II, column II contains the equations of the intensity curves of the different cases; column III contains the true integral values; columns IV and V give the results of applying the two equal distributions to each of the three cases; columns VI, VII and VIII give the results of applying the distributions of Cases I, II and III to each of the three cases; and, finally, column IX gives the results of applying the equiangular arrangement of eleven mirrors to each of the three cases, in order to see how accurately the Matthews photometer, as ordinarily constructed, gives the mean spherical value. In each column, the differences, Δ, between the values found and the true integral values are given.

From a consideration of Table II it seems clear that the distribution of mirrors corresponding to Case III satisfies all the cases most completely, the greatest error being well under 0.1 per cent. The equal distribution 4½°, 13½°, — — — — 175½°, however, is very satisfactory, the greatest error being about ½ per cent. The equal distribution of eleven mirrors every 15° (0°, 15°, 30° — — — — 180°), may give errors amounting to over 2 per cent.

TABLE I.

Various Distributions of Mirrors.

Equiangular distributions.	Distribution satisfying Case I (I = 1).	Column III minus Column II.	Distribution satisfying Case II (I_θ = sin Θ).	Column V minus Column II.	Distribution satisfying Case III (I_θ = cos Θ).	Column VII minus Column II.
0°	4½°	5° 12′	+42′	5° 10′	+40′	4° 29′	— 1′
9°	13½°	13° 44′	+14′	13° 44′	+14′	13° 26′	— 4′
18°	22½°	22° 39′	+ 9′	22° 37′	+ 7′	22° 23′	— 7′
27°	31½°	31° 36′	+ 6′	31° 33′	+ 3′	31° 16′	—14′
36°	40½°	40° 34′	+ 4′	40° 31′	+ 1′	39° 49′	—41′
45°	49½°	49° 33′	+ 3′	49° 29′	— 1′	50° 12′	+42′
54°	58½°	58° 32′	+ 2′	58° 26′	— 4′	58° 44′	+14′
63°	67½°	67° 31′	+ 1′	67° 23′	— 7′	67° 37′	+ 7′
72°	76½°	76° 31′	+ 1′	76° 16′	—14′	76° 34′	+ 4′
81°	85½°	85° 30′	+ 0′	84° 50′	—40′	85° 31′	+ 1′
90°							

It is impossible, of course, to take into consideration all the actual forms of intensity curves existing, but it would seem that a distribution of mirrors which will satisfy the three typical curves considered would also satisfy any of the ordinary forms of curves with which we are familiar in the photometry of such sources as incandescent lamps. Thus Case I approximately agrees with the polar intensity curve of a Sterling "special," or of a Shelby lamp; Case II, with that of a "hairpin" filament, and Case III, with that of a Nernst or of a "meridian" lamp.

The investigation is extended in a similar manner to the location of the mirrors in the Russell-Léonard photometer, with one essential point of difference, however. Since in the theory of the latter instrument the zones are all of equal area so that the mean spherical intensity is the unweighted arithmetical mean of the mean intensities of the various zones, we merely seek to determine the position of the mirror in each zone corresponding to the mean value of the intensity for that zone, i. e., we seek the angle corresponding to the mean

TABLE II.

Results Obtained by Applying the Various Distributions of Mirrors to Each of the Three Cases.

	Intensity curves considered.	Integral solutions.	Equiangular distributions of mirrors. 0°, 9° — — — 90°.	Equiangular distributions of mirrors. 4½°, 13½° — — — 85½°.	Solution of Case I.	Solution of Case II.	Solution of Case III.	Application of equiangular distribution 0°, 15°, 30°, etc. (Matthews' case).
Case I	I_θ = constant = 1	.6366	.6353 Δ = 13	.6373 Δ = 7	.6366 Δ = 0	.6388 Δ = 22	.6368 Δ = 2	.6330 Δ = 36
Case II	$I_\theta = 2a \sin\Theta = \sin\Theta$	.5000	.5000 Δ = 0	.5000 Δ = 0	.4990 Δ = 10	.5000 Δ = 0	.5000 Δ = 0	.5000 Δ = 0
Case III	$I_\theta = 2a\cos\Theta = \cos\Theta$	.3183	.3157 Δ = 26	.3196 Δ = 13	.3213 Δ = 30	.3230 Δ = 47	.3183 Δ = 0	.3110 Δ = 73

value of I_θ for the zone, whereas in the Matthews instrument, as we saw above, we seek the angle corresponding to the mean value of $I_\theta \sin\Theta$ for each of the zones into which the surface of the unit sphere is divided. Moreover, since the general design of the Russell-Léonard photometer is very similar to that of the Matthews instrument for arc lights with the smoked sectored disc omitted, the investigation of the Russell-Léonard instrument is made to include the consideration of the best arrangement of mirrors for arc light photometry, as well as the best arrangement for incandescent lamp work. For the general equations and numerical computations the reader is referred to the more detailed paper in the *Bulletin* of the Bureau of Standards.

Increasing Central Station Loads.

A study of the conditions and methods of modern business brings to light many radical changes in comparison with the practice of the past. Time was—and not so long ago, either—that a merchant invested his capital in a stock of goods; installed his collection of wares in a store; inserted an advertisement in the newspapers, and then sat down to wait for a voluntary stream of customers to throng his establishment with money burning in their pockets. To-day the competition of business life is so keen that these simple methods are inadequate, and every tool that can be utilized in the securing of new customers and trade must be pressed into service. In many different kinds of business the conservative waiting policy of a few years ago has given way to tactics heretofore sacred to the persuasive insistence of the life insurance man and the book agent; and although there is reason to believe that this sort of aggressiveness may easily be carried too far, there is no doubt that originality and initiative bring higher rewards and more lasting profits to-day than ever before.

In the electrical field this tendency toward a more vigorous prosecution of business is plain at first sight, and doubtless the uphill struggles of the earlier days of this branch of applied science to obtain a footing in commercial affairs is in part responsible for the energy with which electrical development has been pushed to the front. It is only necessary to point to the telephone industry to illustrate the power of advertising and personal soliciting in increasing the earning possibilities of one's physical plant. Throughout the country the newspapers of progressive communities are technically enlivened by succinct, pithy phrases, which point out the usefulness and superiority of the telephone over the mails and the telegraph. Electric railways are paying more attention in these days to the increasing of their traffic by advertising in cars and at points along their routes, and even the central station has begun to look afield for new business. There is room for much greater endeavor in gaining new loads, however, and it would seem worth while to point out a few considerations bearing upon the subject.

The great competitor of the central station is the isolated plant. Every kilowatt-hour generated by an isolated plant located within the nearest central station's radius of profitable distribution means

a loss of from two to fifteen cents' worth of potential revenue. From the standpoint of the central station man every isolated plant that can be kept from constructive realization means a probable rescue of several hundred dollars of gross revenue per annum. The conditions which surround every new office or industrial building are never exactly like those of preceding installations, and there is room for expert advice in determining whether current should be purchased from the central station or generated on the spot. It would seem trite to say that the central station man's business is to show the building owner almost before the foundations are designed that he should buy current of the lighting or power company if it were not for the fact that the large number of new isolated plants constructed within the past two or three years shows that the central station's new business department has in some cases been completely defeated. The needs of different customers must be grasped quickly and the arguments of the solicitor driven home with tact and intelligence. Everything helps, from a knowledge of the slide rule and reading monthly bills from handy curves plotted on a pocket card to the ability to convince the prospective customer that his choice of a current supply is a problem of immediate importance.

A fertile field lies in the examination of isolated plants which have grown old in service, with a sharp eye out for wasteful operation. With modern equipment, power concentrated in large units and an expert organization and inspection generally far exceeding the oversight which an isolated plant can afford, the central station possesses all the advantages of a wholesale against a retail establishment. Unless an isolated plant is looked after pretty carefully its cost of generating current is bound to increase very considerably, and here it is that the central station man who is well armed with figures and keen observation finds a chance to score his most telling points. These things are mentioned with the latter's needs in mind, rather than with any intention to decry the usefulness and economy of isolated plants. The choice between the central station and the isolated plant is a problem in engineering economics beyond the scope of these comments.

Anything which tends to increase the familiarity of the general public with the advantages and usefulness of electricity in business houses and domestic establishments is pretty sure to work toward increased revenue. The practice of the Boston Edison Company furnishes a good illustration. For some time the company's office at Head Place has been extensively advertised through its free exhibition of electrical apparatus capable of showing just what can be done in the home, office and factory with purchased current. Not long since the street cars and newspapers of Boston carried frequent announcements of these exhibitions, and many interesting devices were shown to the public, familiar though they are to the engineer.

Much has been written of late about the new business methods of the Denver Gas & Electric Company. This organization strives to keep in close touch with the public as well as its established customers, and maintains a commodious waiting room at its general offices for the use of the men and women who wish to wait for cars, make appointments, and in general have some center of convenience down town. Electric heating and lighting apparatus of various kinds is exhibited here, and in the building is a demonstration hall where lectures are often given at the company's expense on gas cooking, electric heating, lighting or other kindred subjects. Information is at hand for the mere asking concerning any equipment, prices or processes brought before the public's attention, and from time to time pamphlets are distributed in a sort of educational campaign. One of these gives an interesting partial list of the uses of electricity and gas for industrial purposes. Omitting the special application of gas, the electrical uses enumerated form a list well worth the consideration of the central station solicitor; thus, in alphabetical order we have assayers, electric motors, automobile, bicycle and tin shops; charging apparatus, motors and soldering irons; bakeries, confectioners, lunch stands and wagons; motor dough kneaders, motor ice cream freezers, lights, fans; barber shops, chiropodists and manicuring; fans, breweries and bottling establishments; motors for builders and contractors; electric hoists, excavators, stone dressers and crushers; churches, motors for organ blowers; coffee and tea merchants, motors for grinding coffee and for running roasters; commission merchants and markets, motors for ice machines and general uses; dairies and creameries, ventilating fans, water boilers, ice cream freezers, cream separators, churns; drug stores, fans; dry goods and dressmaking shops, sewing machine motors, fans, flatirons, tailor irons, curling irons, cloth cutters; express and railway offices, banks, etc., fans; hotels, restaurants and saloons, fans, electric pianos, coffee pots, ice machines, sign lighting, window lighting, dumb waiters, ice cream freezers, elevators; laundries, ventilating fans, motors; newspapers and printing offices, fans and motors; photograph galleries, arc lamps for blue printing, enlarging and portrait photography, fans; residences and apartments, porch lights, motors for sewing machines, fans, decorative lighting, electric pianos, heating appliances, chafing dishes, water bags, flatirons, curling irons, foot warmers, hot plates and broilers, water boilers, coffee pots, electric lawn mowers, ice machines, motor dumb waiters, elevators, private yard lighting; shirt, overall, tent and awning factories, electric cloth cutters, sewing machines, flatirons, ventilating fans, general motors; stores, blocks and office buildings, pneumatic tube service, elevators, hoists, sign and window lighting, outline lighting, fans, miscellaneous power, show case lighting, summer business of isolated plants, electric needles for pyrography; surgeons, dentists and physicians, static machines, violet rays (arc lamp) dental motors, lathe motors, electric needles, fans; stables and liveries, electric horse clippers, fans; tailors, hatters, cleaners and dyers, cloth cutters; wagon makers, carpenters and wood workers' shops, soldering irons and miscellaneous motors.

Other uses of current will readily occur to the central station man, but enough has been cited to furnish a liberal supply of texts to be used in gaining new business. The possibilities of effective lighting are almost unlimited, and the use of electric motors for driving every sort of machinery has been so thoroughly discussed that no further reference to it is needed at this time. Electric light and power men have long realized the advantages of a substantial day load, but it is only recently that central station managers have appreciated the elusive character of this sort of new business, which must be vigorously hunted down and run to earth if it is to be retained.

Auditing for Telephone Companies.

Auditing was the subject of a paper presented before the recent convention at Harrisburg of the Pennsylvania State Independent Telephone Association, by Mr. I. D. Gindhart, Jr., of the Keystone Telephone & Telegraph Company, of Philadelphia. No attempt was made to elaborate any special system of auditing, the author's purpose being mainly to draw attention to the value of auditing as an accessory to the success of independent telephony. The aim of the auditing department, he stated, is primarily the careful recording of all income, crediting the respective sources, and seeing that all disbursements are duly accounted for and charged in such a manner that the expenses of the business may be easily determined and regulated. Comparative records of districts will often be the cause of dismissing a careless and expensive district manager and also prove that the industrious and conscientious manager of another district is making things pay. He pointed out the importance of keeping an itemized cost of construction, making a daily report of stock receipts and disbursements and comparative reports of earnings per trunk.

The former difficulties of settling for toll business have been removed by the reference of such matters to traffic associations. In these days of consolidation, standardization was the keynote. Mr. Gindhart suggested a Telephone Auditors' Association for the purpose of standardizing the accounts of telephone companies, using a system elastic in its principles applying to the small as well as to the large companies. A standard and uniform system of accounting, he said, in conclusion, is of as much importance as the standardization of equipment and lines, and the benefits accruing from it will be found to be as great.

What Electricity Does.

The following interesting excerpt is a literal transcript from a Civil Service thesis recently filed not far from New York City Hall on the subject of electricity: "Electricity is the most and greatest invention's that ever existed. they invent all kinds of musical instruments such as graphaphones and phonographs and sewing machines and electric lights and trolley cars and it acts quicker than steam. Silk mills is also run by motors & Dynamos. of course I think we will have flying machines in time that is run by electricity & its got a great effect in shock and electric bells in use for ill people."

Electric Traction at the International Engineering Congress.

At the International Engineering Congress, which held its sessions at St. Louis during the week of October 3-8, three papers were read relating to electric traction.

One of these was by Mr. J. G. White, the title being "The Substitution of Electricity for Steam as a Motive Power," and another by Mr. L. B. Stillwell on "Electric Power Generating Stations and Transmission." The third paper presented was by Mr. Alexander Siemens, the title being "The Substitution of Electricity for Steam as a Motive Power."

Mr. White, in his paper, very thoroughly considered every bearing of the subject, which was discussed under several general heads with numerous sub-heads. Much practical data were given relating to the operation of present electric railways, with illustrations from these showing the advantages to be derived from electric traction. The conclusions of the paper are as follows:

1. There should always be a substantial, and, under favorable circumstances, a very large increase in gross receipts, due to specific advantages of electric traction, among which are:

(*a*) Increased general comfort of passengers, contributed to by greater cleanliness, better ventilation, more brilliant and better distributed lighting, and more equal heating of cars.

(*b*) Higher speeds, due largely to increased accelerations, rather than to higher maximum speeds. Such accelerations are obtainable because of increased traction coefficient, due to uniform torque, use of powerful motors, and to greater weight on driving wheels.

(*c*) More frequent service, either with single cars, which can be operated at a cost justified by their earnings, or by trains operated by multiple-unit control, of such length as will accommodate the changing volume of traffic.

2. There will be a considerable increase in capital invested, with proportionate increase in fixed charges.

The total cost of rights of way, roadbed, tracks, stations, signaling systems and similar minor items should, although differing in detail, be substantially the same.

The cost of rolling stock should be nearly the same, although electric motors and trucks, with accessories, usually cost slightly more than locomotives of the same aggregate capacity.

The cost of central power station and of distributing and contact systems is a large item, against which steam equipment has ordinarily no counter charge.

In exceptional cases increased capacity of lines and terminals may be secured by electric equipment with less investment than in any other way. Such increased capacity will be due principally to the higher average speeds, making it possible to run more trains, more rapid operating of trains into and out of terminals, increasing their capacity by as much as 100 per cent., or by use of electric locomotives more powerful than any steam locomotive which can be constructed under existing limitations.

3. Operating costs on exceptional roads will be somewhat decreased under electric traction. On other lines, still favorable to electric traction, operating costs will increase, but the gross earnings will be increased by a larger amount.

More in detail, general expense should not be substantially altered; maintenance of way and buildings should be slightly less with electric traction, owing to the absence of pounding of reciprocating parts of locomotives, better distribution of weights and absence of deleterious gases.

Owing to absence of smoke and gases, maintenance of cars, etc., should be moderately less, while the maintenance of motor equipment will probably be less than 50 per cent. of the cost of maintaining locomotives for equal service, partially offset by repairs to stations and distributing systems.

Wages should be somewhat less, due partly to the possibility of securing men at lower rates per hour, but more especially to increased mileage attained, partly because there is no necessity of waiting about in terminal yards with steam up until called for.

Ordinarily fuel costs will not greatly differ, although substantially less with electric traction in favorable cases. Fuel cost may, in exceptional cases, be slightly reduced by return of current to line on down grades, and during certain periods of retardation, but ordinarily this is not justified. In special cases power costs may be reduced by the use of water power, or in other ways, such as sale of current for light and power in a territory occupied by lines electrically operated.

On the whole, total operating costs will not greatly differ, but whether they will be increased or decreased can be determined only by careful study of each special case. Rarely, if ever, will operating costs be reduced sufficiently to cover interests on additional investments required, the expected gain from conversion being from increased receipts.

The relative importance of the different items entering into operating costs may be better appreciated by some specific figures. For the year 1903 the total expenses of the Pennsylvania division of the Pennsylvania Railroad were $47,722,082, of which

Locomotive repairs amounted to	$3,886,860
Locomotive fuel	4,716,485
Locomotive labor	4,154,057

It is thus clear that each of these three items approximates 10 per cent. of the total operating expenses, so that they are about equally important. For reasons given in the body of the paper it seems probable that saving in locomotive repairs and locomotive wages are each likely at times to exceed savings in fuel, although the latter has frequently received nearly all the attention in discussions.

4. With thoroughly good equipment, there should be little difference between the two systems, as to reliability and safety, but with inferior installations electric equipment will suffer by comparison from somewhat greater chance of interruption to service and increased fire risks, which will, however, be offset, partially at least, by there being no steam or smoke to obscure signals.

In 1895 the Manhattan Elevated Railway made gross earnings of $9,731,231 and net earnings of $3,524,939. In 1901 the gross earnings were $10,253,271 and the net earnings $4,132,016. In no one of the intervening six years were net earnings so large, the average being about $3,100,000. For the year ending June 30, 1904, gross receipts are reported to have been $14,529,188, and net earnings $7,811,462. For the seven years before the commencement of electrical operation, the net earnings were largest in the first of these seven years (1895), and during this whole period the average annual gross earnings were practically constant. The large increase in both gross and net earnings must consequently be due almost entirely to electrical equipment. The increase in net earnings approximates 23 per cent. on the cost of electrical equipment.

5. As to available systems of electrical equipment, in nearly all cases where electrical conversion is justified, direct-current motors alone deserve serious consideration. These should be supplied from direct-current generators, for compact systems operating within a radius of perhaps six miles from the generating station. With greater distances current should be supplied from alternating generators through rotary transformers.

If single-phase motors are as well developed as the manufacturing companies claim, they merit consideration where an infrequent service is operated, especially at considerable distance from the power station. Assuming that accounts of the present development of the single-phase system are not too optimistic, three-phase or other systems will have practically no status in future conversion studies.

6. As to probable developments, within a few years the New York Central and Pennsylvania Railroads will have useful data from their New York installations. It seems probable that their suburban service will be gradually extended, as likewise the suburban service of the New York, New Haven & Hartford Railroad. Having tunnels in Washington, Baltimore and Philadelphia, and crowded terminals in the latter cities, it seems reasonably probable that the electric service of the Pennsylvania Railroad will ultimately be extended to Washington and be made to include its suburban business from Philadelphia. Before that time, however, other suburban roads will probably be electrically equipped from such cities as Chicago, Philadelphia, New York and some smaller cities.

Within a few years a considerable number of suburban lines in and about London, Paris, Berlin and the smaller European cities should be converted to electrical operation. Some interurban steam roads are also likely to undergo conversion, even where traffic is now light—as on the Italian roads previously mentioned, provided a considerable increase in gross passenger earnings is likely to result.

Other than as above, the cases of electrical conversion are likely to be rare, justified only by exceptional circumstances.

The conversion of main trunk lines and freight roads does not deserve serious consideration, except in rare instances, where increased capacity is urgently needed, and not otherwise attainable at reasonable cost, or if operating through frequent or long tunnels.

The paper by Mr. White was discussed in great detail by Mr. L. B. Stillwell. Mr. Stillwell referred to the ambiguity of the word "depreciation," which sometimes is synonymous with maintenance or upkeep. Referring to the class of steam lines on which it would not pay to substitute electric traction, he suggested as a criterion that might apply that electric traction is not applicable to service of which the traffic per day does not exceed 10,000 ton-miles per mile of double track. He dwelt upon the importance of the factors of cleanliness, ventilation, lighting and heating, the first mentioned being of particular importance with respect to cities through which the railways pass. The increase of speed has a two-fold importance, first with respect to doing a given business with a rolling stock equipment decreased in proportion to the increase in speed; and second, the public is enormously attracted by higher speed which enables it to get from point to point in less time. Referring to single-car and the multiple-car trains, it is stated that the greater amount of power required for the single cars does not cut a very large figure in the total expenses. For example, if on the Manhattan the cost of power were doubled the total cost of operation would only be increased from 10 to 11 cents per car-mile. Referring to the power per ton-mile on the Manhattan, which Mr. White gave in his paper as about 125 watt-hours, Mr. Stillwell said that this actually was about 82 watt-hours per ton-mile at the power house and 70 watt-hours per ton-mile at the third rail. He referred to the adaptability of electric motors for heavy grades—grades of from 6 to 10 per cent. not being obstacles. Such grades would be safe for electric traction owing to the very perfect braking arrangements of which it admits.

Referring to a statement by Mr. White that the cost of an electric power station and distributing station system would be about $130 to $150 per kw capacity, including buildings and land, Mr. Stillwell pointed out that these figures apply only to stations of average size and that they refer to rated capacity. Some stations of 40,000 to 50,000 kw have been built complete for about $110 per kw capacity, and it is important to bear in mind that the output can be safely increased 40 per cent. over this during rush hours. As to the relative weight of the turbine and reciprocating engine units, the larger sizes of the latter weigh about one and one-half times the former. In the case of a 500-kw unit this weight is only ⅛ that of the corresponding reciprocating engine unit.

Mr. Stillwell expressed the opinion that maintenance of way would be a lesser charge with electric traction owing to the elimination of the unbalanced parts of the steam locomotive, and the lesser weight required for a given drawbar pull. He contested the statement that there would be no saving in full consumption with electric traction. The New York Manhattan road is operating on 2.6 pounds of coal per kw-hour, or 3 pounds at the drawbar, while 3.5 pounds is a very low figure for steam locomotives. He considers that with electric traction not more than one-half the fuel will be required, and it may be nearer a third than a half. The New York Central could save half and perhaps two-thirds of its coal bill, amounting at present to four or five million dollars per year. The cost of power on the Manhattan, he said, is about 6 mills per kw-hour, or including capital charges, about 9 or 10 mills. Electric traction permits the use of the most economical generating apparatus, such as gas engines, which promise to produce a horsepower-hour on one pound of coal.

Mr. Stillwell considered that the third rail is one of the great objections to electric traction, and he favored the use, where practicable, of the suspended trolley conductor. He pointed out with respect to relative reliability, that on the Manhattan the delays in traffic with electric power were less than 40 per cent. as numerous as when steam power was used. He referred to the effect of cold weather on steam traction, which would not be the case with electric traction. He did not approve a suggestion for cutting off power if a train passes its signals, but favored means for applying the brake. He did not see that any good object would be served by a rule prohibiting the carrying from one car to another of wires carrying heavy currents, as such wires can adequately be protected. As to dividing the contact system into short sections, this he believed would merely complicate matters and result in increased risk with no corresponding benefit. He recommended the testing at regular intervals of car equipments with a voltage three or four times the normal voltage. To such tests he ascribed the immunity of the Manhattan equipment from accidents.

Referring to a statement that the total loss with alternating current is about 17 per cent. and 24 per cent. with direct current, Mr. Stillwell said that within the limits of the proper application of direct current to electric traction, the loss does not exceed 15 per cent. As to the superior torque of direct-current motors, he pointed out that the polyphase motor developed sufficient torque to stop the wheels, and therefore could not be considered defective with respect to torque. He stated that tests recently made by the Ganz Company showed that polyphase motors can temporarily carry four times their load without falling off more than 7 or 8 per cent., and no direct-current motor can do more than this. As to the great weight of polyphase motors, this only follows when a large clearance is used. By a proper construction the Ganz Company produces such motors weighing no more than direct-current motors, and costing no more. The recently announced American single-phase motors weigh no more than direct-current motors.

Mr. Stillwell challenged the statement that the return of energy to the track, using polyphase motors, involved complications rendering it inadvisable under usual conditions. He referred to a test of a week or more of the Ganz system, on a train of seven cars. In running down grades it was found that more than 70 per cent. of the energy was restored to the line, and this figure would have been higher with steeper grades. The Ganz Company, in a specific case, guaranteed a restoration exceeding 20 per cent.

As to hours of service, the average for steam freight locomotives on the New York Central is but a little more than 75 miles per day, while with electric traction at least twice that mileage could easily be made, and therefore require half or less the number of locomotives. The maintenance and upkeep of electric locomotives may be placed at 2½ per cent. per annum, while the rate for steam locomotives is 20 per vent. In conclusion, Mr. Stillwell said he could not agree that when electrical conversion is justified direct-current motors alone deserve consideration. On the contrary, he believes the time has arrived when not only the recently announced types of single-phase motors, but also polyphase motors, should be carefully considered with respect to each individual case presented to the attention of the engineer.

Mr. Stillwell, in his paper, discusses the subject under the heads of development of systems, progress in transmission, overhead transmission, underground transmission, organization of circuits and storage batteries. In the first section of the paper a very interesting account is given of the development of electric traction, generating machinery and motor systems. It is shown that the development in power generators has led to radical changes in power station design, particularly in recent years. Under the head of transmission the subject of installation, lightning arresters, steel towers, cables, conduits, etc., is discussed.

In conclusion, the author points out that while the last ten years have been characterized by material progress in the design and construction of electrical apparatus used for the generation and transmission of power, it would be quite erroneous to infer that electric apparatus is not to-day fairly comparable with other classes of mechanism used in the industrial arts with respect to stability and permanence of type.

It is true that the line insulators of 1894 are, with rare exceptions, no longer used, that lightning arresters during the last decade have been much improved, that oiled paper has largely superseded rubber as insulation for underground cables conveying high-potential circuits, that the switches now used for high-potential, alternating currents of large power are unlike anything thought of ten years ago, that dynamos and transformers, as now built, are more efficient and durable, and that in the best plants of to-day important features in the organization and connection of circuits and in the use of automatic circuit-breaking devices have been introduced which in 1894 were not conceived. But it is not true that a majority of electric apparatus essential to the generation and transmission of electric power is now in a stage of rapid development. On the contrary, changes with respect to the specific apparatus just mentioned have been relatively slight during the last five years. They were much more radical in the first five years of the last decade, and the opinion may be advanced, perhaps with safety, that dynamos, transformers, switches, measuring instruments, insulators, lightning arresters, cables, conduits, circuit-breaking devices, automatic and other, as now

available on the market, have reached a reasonably stable condition in the evolution of the art, and with respect to these constituent parts of the electric systems for generation and transmission of power, no such rate of change, as has been observed during the last ten years, is likely to occur during the coming decade.

The paper by Mr. Alexander Siemens sketched the development of the electric motor from the electromagnetic engine of Joseph Henry down to the latest single-phase types of traction motors. A brief account is given of the German high-speed electric traction experiments. Mr. Siemens considers that the results of those thus far conducted have justified the following conclusions:

1. Permanent way, constructed in accordance with the standard specifications for first-class main lines of the German Government railways, is sufficient for electric trains running at a speed of 125 miles an hour, but the radius of any curve should not be less than 100 chains.

2. The collector used in the Zossen experiments is well adapted for conveying electric energy at high tension and at high speeds from fixed conductors to cars.

3. The construction of the fixed conductor employed in the German high speed trials has been proven equal to the service.

4. The Zossen trials have demonstrated that high-tension current can be used direct without the intervention of transformers.

The paper summarizes the use of electric over steam traction, against which, however, should be balanced losses in electric traction caused by double transformation of energy and the interest on the additional capital expenditure. The final conclusion of the paper concerning the relative positions which the steam engine and electric motor occupy at present is that it is more correct to regard the one as the supplement of the other than to expect a complete substitution of electricity for steam as a motive power.

Mr. L. B. Stillwell, in the discussion of Mr. Siemens' paper, said that the statement therein that whereas "direct-current motors are most suitable in cases where the speed of running has to be varied often and to a great extent, alternating-current motors are more efficient in cases where long runs at constant speed are required," represents the opinion of many engineers in this country. An interesting point is that the single-phase motor requires more weight on the driver than the polyphase motor for a given drawbar pull. The torque of the former varies with the frequency, and theoretically the average torque is one-half the maximum. In some tests made for Mr. Stillwell at Budapest this ratio was found to be actually 3 to 2. The polyphase motor has almost a uniform torque, while that of the single-phase is pulsating, and consequently the slip at the top of the pulsating torque and the average weight are much less than that for the effective drawbar pull. The electric motor has a great advantage over the locomotive engine in applying the power developed. Both English and American tests have shown that only about 43 per cent. of the power developed in the steam cylinder appears at the drawbar.

Electrifying a Colorado Steam Railroad.

Steps are being taken to electrify a part of the Colorado & Southern Railroad. The Denver & Interurban Company is an organization of Colorado & Southern officers, which proposes to build, equip and operate electric roads, etc., in the State of Colorado, beginning with the existing line of the Colorado & Southern between Denver and Boulder, a distance of 30 miles, for passenger service only. It is also proposed to build a line within the limits of the city of Denver on some of the principal business streets, and later on to apply for a general franchise in the city. Another scheme is to make extensions into the farming communities north of Denver as well as equipping other Colorado & Southern lines running out of Denver. The proposed location of the power house is at one of the coal mines half way between Denver and Louisville, using lignite slack, costing about 50 or 60 cents a ton. A single-phase alternating-current system will be used with 20,000 volts on the feeder line and 3,000 volts on the trolley line. The cars will be 55 ft. long, carrying 60 passengers, and will weigh from 35 to 38 tons. It is intended to start with a half-hourly service out of Denver. The line will branch at a point about 19 miles from Denver, one line running to Boulder and the other to Louisville and La Fayette and the mining districts. The run of 30 miles from Denver to Boulder, it is expected, will be made in 50 minutes, including 11 stops, the motors and equipment being designed for a speed of 60 miles an hour. The freight business and passenger business of the Colorado & Southern will be done on the same line, but the electric service will not interfere with the freight service to any extent.

Western Union Annual Report.

The Western Union Telegraph Company has issued its full pamphlet report for the year ended June 30, 1904. We compare the income account as follows:

	1904.	1903.	1902.	1901.
Gross revenue	$29,249,390	$29,167,687	$28,073,095	$26,354,151
Operating expenses	21,361,915	20,953,215	20,780,766	19,668,902
Net revenue	$7,887,475	$8,214,472	$7,292,329	$6,685,249
Interest on bonds	1,157,700	1,077,700	992,580	956,160
Net profit	$6,729,775	$7,136,772	$6,299,749	$5,729,089
Dividends	4,868,071	4,868,050	4,868,031	4,868,008
Surplus	$1,861,704	$2,268,722	$1,431,718	$861,081
Previous surplus	13,019,725	10,751,003	9,319,285	8,458,205
Total surplus	$14,881,428	$13,019,725	$10,751,003	$9,319,286

The surplus after operating expenses and bond interest amounted to $6,729,775, and is equal to 6.91 per cent. earned on the $97,370,000 capital stock.

Expenses in detail for the last four years were as follows:

	1904.	1903.	1902.	1901.
General expenses and taxes	$15,736,592	$15,553,337	$15,302,739	$14,511,986
Rental of leased lines	1,600,885	1,567,706	1,568,534	1,569,640
Maint. and reconstruc.	3,627,196	3,431,822	3,591,065	3,270,425
Equip. of office and wires	397,242	400,350	318,428	316,852
Total	$21,361,915	$20,953,215	$20,780,766	$18,,668,902

The following table gives some interesting statistics:

	1904.	1890.	1880.	1867.
Miles of pole and cable	199,350	183,917	85,645	46,270
Miles of wire	1,155,405	678,997	233,534	85,291
Offices	23,458	19,832	9,077	2,565
Messages	67,903,973	55,878,762	29,215,509	5,879,282
Receipts	$29,249,390	$22,387,029	$12,782,895	$6,568,925
Expenses	$21,361,915	$15,074,304	$6,948,957	$3,944,005
Net revenue	$7,887,475	$7,312,725	$5,833,938	$2,624,920
Av. toll per message	31.7	32.4	38.5	.....
Av. cost to Co. per mess.	26.1	22.7	25.4	.....

The general balance sheet as of June 30, 1904, compares as follows:

Assets:	1904.	1903.	1902.
Tel. lines, stks. own., franch., pat., etc.	$114,539,686	$112,073,906	$108,714,146
Stocks and bonds of leased companies	8,504,000	8,504,000	8,504,000
Other securities, etc.	12,634,345	11,459,416	9,727,988
Real estate	4,682,606	4,765,130	4,765,130
Supplies and materials	542,340	498,011	344,775
Sundry accounts, receipts, etc.	2,221,813	2,156,365	2,302,172
Cash	2,414,103	2,678,016	2,665,310
Total	$145,538,894	$142,134,744	$137,023,522
Liabilities:			
Capital stock	$97,370,000	$97,370,000	$97,370,000
Funded debt	25,504,000	24,504,000	21,504,000
Gold & Stock Telegraph Co.	1,946,592	1,946,592	1,956,592
Sundry accounts payable	4,238,690	3,696,244	2,842,744
Surplus prior to Oct. 1, 1881	1,598,184	1,598,184	1,598,184
Surplus since Oct. 1, 1881	14,881,428	13,019,725	10,751,003
Total	$145,538,894	$142,134,744	$137,023,522

There was an increase of $81,704 in the revenue of the year and of $408,700 in the expenses. Of the last named amount $195,374 was in maintenance and reconstruction of lines, including nearly $100,000 for repairs to the company's transatlantic cables, and $183,255 was in operating and general expenses, including removal and improvement of offices, etc.

During the year fifteen more old primary battery plants were supplanted by dynamo plants and President Clowry states that the saving is so great as to recoup in the first year nearly the whole expense of making the change. Contracts were made with railroads covering 2,512 miles of road.

New Telephone Patents.

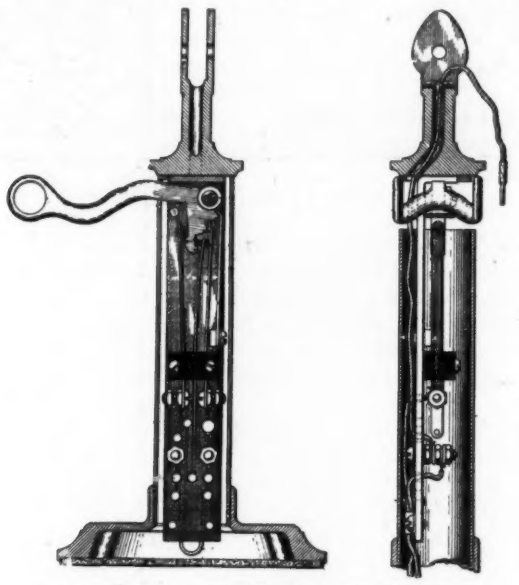
IMPROVED TRANSMITTER.

For a considerable time the proposition has been advanced by some that a transmitter diaphragm, to produce the maximum effect should have no means of support except that furnished at its middle by the movable electrode stud, and transmitters so designed have been patented. E. B. Fahnestock, of New York City, now brings forward the statement that a transmitter of this type may be improved in efficiency if the damping effect of the free air space behind the diaphragm can be decreased, and he finds that he can

decrease it, if he can protect the rear of the diaphragm from inpinging sound waves. This latter may be accomplished by sealing in the space behind the diaphragm and thus making it a dead air space. Several suitable means of sealing are described in a patent recently issued to Mr. Fahnestock. For horizontal diaphragms, the edge may be flanged downward and dip into a mercury seal. Again such a flange either vertical or horizontal may be sealed by a flexible cement. Thirdly, the flange may be omitted and the air space sealed by a flexible annular diaphragm.

"KNOCK-DOWN" TELEPHONE.

An apparatus, the patent for which has been assigned to the Western Electric Company, is a "knock-down" desk stand set, a good idea



BOYCE "KNOCK DOWN" DESK TELEPHONE.

of the arrangement of which may be obtained from the sectional view given in cut. All working parts are contained within the tubular upright, from which they may be withdrawn as a unit.

CURRENT NEWS AND NOTES.

THE CANADIAN PACIFIC is to work telephones over its telegraph lines along the railroad west of Winnipeg.

RAILROAD MOTOR CARS.—Within three months the Union Pacific Railroad Company will have in operation several gasoline motor cars between Omaha and local stations on its Nebraska line. An order has been placed for material for the construction of the new cars, and they will be built in the Omaha shops as quickly as possible. The operating department has had many plans drawn and submitted for motor cars, and the plans it has accepted are for cars with a carrying capacity of thirty persons each and a speed of sixty miles an hour.

ELECTRIC LIGHTING IN ST. JOHN, N. B.—United States Consul-General Holloway states that the City Council of St. John, New Brunswick, may decide to purchase the plant which provides electric lights for the west side of the city and run it as a civic enterprise. The following statement shows the present expense: Cost of lighting north end of city from an electric light station owned by the city, $75 a light; cost of lighting east end of city by lights rented from the street railway company, $85 a light; cost of lighting west end by company which it is now proposed to buy out, $105 a light.

UNDERWRITERS' MEETING.—The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, New York City, on Wednesday, December 7, 1904, at 10 a.m. As in the past, the meetings will be open to all interested in the matter of rules for the installation of electric wiring and apparatus, as contained in the National Electrical Code. Reports of committees and all suggestions for changes in the code to be acted upon at this meeting should be in the hands of the secretary by November 5, in order that they may be put into print for the meeting. Mr. C. W. Goddard, 55 Kilby Street, Boston, is secretary.

AN ALPHABET OF RAYS will soon be compiled. There are more coming. We are now up to "N." As already intimated, M. di Brazza, a student of Liege, claims to have discovered a new sort of ray, which he calls the I-rays. "Prof. Charpentier, of Nancy, has surmised that the brain is the seat of an emission of N-rays, and M. di Brazza thinks he has proved it. The I-rays differ from N-rays in passing through moist substances. When a subject concentrates his will the I-rays from his brain cause changes of luminosity on a phosphorescent screen. When his attention is not concentrated the light does not flicker. The rays are not emitted equally from all parts of the head. They are nil at the forehead and upper part of Broca's center, increase at the temples and eyes, and reach their maximum behind the ears. Orthochromatic plates are used in taking photographs of the rays."

PHILADELPHIA BRANCH A. I. E. E.—The 13th meeting of the Philadelphia Branch of the American Institute of Electrical Engineers was held on Monday, October 10, at the rooms of the Engineers' Club, that city. A very clear and interesting paper on "Wireless Telegraphy" was presented by Mr. C. D. Ehret. The paper covered the ground of wireless telegraphy completely, both historically and technically. There was a short discussion in which Messrs. Eglin, McClellan and Braddell took part. The members were then taken under charge of Mr. J. W. Kelley, Jr., to visit the plant of the Keystone Telephone Company, at Second and Sansom Streets. Through the efforts of Mr. Kelley, Mr. Ulrich, the traffic manager of the company, and their assistants, the visit was very interesting and the meeting did not break up until midnight. The next meeting of the branch will be held Monday, November 14.

NERNST LAMP PROGRESS.—An interesting paper was presented last week before the Michigan Electric Association, at Detroit, by Mr. E. R. Roberts, on the Nernst lamp as a factor in commercial lighting. After presenting many facts now familiar as to the evolution and perfection of the lamp he says: "While there have been close on to 400,000 glower units placed in service in the United States for various classes of lighting, it will not be attempted at this time to set forth the special adaptability of the Nernst lamp for each class of commercial lighting. With the exception of stage and electric sign lighting and a few other special uses for light energy, the legitimate field of the Nernst is practically identical to that covered by other modern illuminants. Since the policy of using the central station as a medium for marketing its product was instituted by the company in the early part of this year, over 100 central stations have adopted and are supplying the lamp on their circuits. Classifying this list with respect to the size of the different cities represented, we find that the illuminating companies of three cities of over 500,000 population, four cities of over 250,000, three cities of over 100,000, seventeen cities of over 25,000 and seventeen cities of over 10,000 pouulation have adopted the lamp. Of the total number, about 20 per cent. have seen fit to furnish free renewals, putting the lamp out on a flat rate contract basis."

LETTER TO THE EDITORS.

100-KW. Megavolt Transformer.

To the Editors of Electrical World and Engineer:

SIRS:—I was somewhat startled on taking up the ELECTRICAL WORLD AND ENGINEER of October 1 to see your editorial headed "A Megavolt, Megawatt, 25-Cycle Transformer." As the designer and builder of this transformer I wish the rating of 1,000 kw given it by your editorial were correct, as we would then have a formidable piece of apparatus indeed. The real rating, however, is only one-tenth that, or 100 kw. A transformer even of 100 kw capacity wound for such high potentials is, however, far from being a toy and is capable of producing effects which justify the interest in the apparatus which is manifested both in your editorial and by electrical men who have visited the Exposition.

I would call special attention to the fact that the discharges produced by this apparatus must necessarily differ considerably from discharges of similar length heretofore produced because (1) the kilowatt capacity of the apparatus is greater; (2) the frequency is

much lower; (3) the transformer has a closed magnetic circuit and the discharges are of the same general character as are produced by regular commercial high-voltage transformers.

The sparking distance of the transformer, as we are working it for popular spectacular displays at the Exposition, is from 30 to 46 in., but this is between 1-in. rods and not between sharp points. This distance is dependent on and limited by the amount of moisture in the rough pine wood of the shanty in which it is housed. In better surroundings we hope at least a 7-ft. striking distance can be obtained between sharp points. It may be of interest to note that the transformer is supplied direct from the 110-volt secondary of a 250-kw General Electric transformer in the Electricity Building without any regulating apparatus, and we depend on the length of the discharge to give the transformer the proper load.

I regret that your editorial calculations should have inadvertently added a cipher to the rating of this transformer, as I am especially averse to anything that might seem like newspaper sensationalism in connection with this work. I therefore trust you will give space to this correction.

CHICAGO, ILL. C. H. THORDARSON.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Distortion of Voltage Curve in Alternators.—WANGEMANN.—An article on the distortion of voltage curves in alternating-current machines. The advantages and disadvantages of distorted curves are not the same for all cases of practice. A pointed curve is preferable for transformer operation, since the hysteresis losses and the magnetizing current are smaller than with flat curves, for equal effective values. The disadvantages are, however, the greater drop of voltage and the stronger insulation which becomes necessary on account of the higher maximum values. For incandescent lamps and motors the curve form is of smaller importance, although the fear has also been expressed that the motors may more easily fall out of step if generator and motor have voltage and current curves greatly differing from each other. With respect to arc lighting it was tried several years ago to utilize the pointed curves to better advantage by connecting four lamps in series at 110 volts. The lamps burned, but the total illumination was 20 per cent. smaller than when three lamps were used with a flat curve form. The greatest disadvantage of pointed curves is due to resonance phenomena caused by the higher harmonics. For modern high-tension machines which generate voltages up to 60,000 it is absolutely necessary to make the wave form as nearly sinusoidal as possible. The author discusses in detail the different influences which may cause a distortion of the wave form. At no load the e.m.f. of an alternator may be distorted on account of three factors. First, the change in lines of force, the distortion being the greater the smaller the number of teeth and induction. Secondly, the change of the number of lines of force, the distortion being the greater the smaller the number of teeth and the greater the induction. Thirdly, permeability and remanence; the remanence manifests itself in a dislocation of the zero points. If the alternator supplies current, the current curves are distorted on account of the variable self-induction, and the voltage curves on account of armature reaction. Further, if the external circuit contains a large self-induction, the current curves approximate the sine wave, while the voltage curves become more pointed than the no-load e.m.f. curve, the maximum value remaining the same. If the external circuit contains capacity, the current curves remain distorted and the instantaneous values of the voltage curves are increased. If there is no phase difference, the maximum of the voltage curve remains the same as at no load. Finally hysteresis causes the current curve to become more bent in the first half and the voltage curve to become more bent in the second half of an alternation.—*Elek. Zeit.*, September 8 and 15.

REFERENCES.

Compensated Single-Phase Series Motor.—BETHENOT.—The first part of what appears to become a lengthy mathematical article on the theory of the compensated single-phase series motor.—*L'Eclairage Elec.*, October 1.

Commutation.—ILIOVICI.—An account of experiments on the phenomena within the short-circuited section of a direct-current dynamo. He investigated especially the variation in the current flowing in a section during the short-circuit; the voltage induced in a section during the short-circuit; and the variations in the fall of potential between a segment and the brush touching it. The results are given in curves, but no conclusions of a general nature are drawn.—Lond. *Elec. Rev.*, September 30.

LIGHTS AND LIGHTING.

Singing Arc.—MAISEL.—An account of an experimental investigation made to examine the theory of Duddell according to which the fundamental condition to be fulfilled in a singing arc is that dv/di is smaller than zero, where dv is the change of the voltage and di the change of the current in the arc. This condition is fulfilled only with homogeneous carbon, so that if the theory is correct only an arc between homogeneous carbons could be made to sing. The author has, however, made experiments in which he produced the singing arc with iron electrodes and with mercury electrodes. In the latter case the above differential quotient was surely positive. His arrangement for the mercury arc is as follows: Since during each oscillation the arc is extinguished, it must be artificially lighted again. For this purpose he makes the cathode of the tested arc at the same time the cathode of a small artificial arc. In Fig. 1, E is a

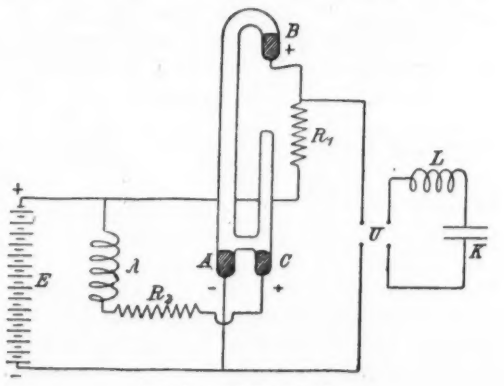


FIG. 1.—SINGING ARC.

storage battery, A the common cathode, B the anode of the main arc, R_1 its regulating resistance, C the anode of the auxiliary arc, R_2 its regulating resistance, U a two-pole switch, L a self-induction and K the capacity of the condenser circuit. In the circuit of the auxiliary arc a reactance coil is inserted in order to keep the current constant. In the large arc AB (18 cm. long) the current was 2 amp., the voltage 30; in the small arc AC the current was 1 amp. Thus Duddell's conclusion has been shown not to agree with the facts. It had been developed mathematically under the supposition that the current is sinusoidal, or what is really the same, that the energy of the oscillations is supplied exclusively from the condenser circuit. But it has been shown that the current wave in the condenser circuit is far from being sinusoidal. The author gives the following theory of the singing arc. If the arc is first burning quietly and self-inductance and condenser are then connected in shunt, the electricity will flow in large quantity to the capacity. If the main current is not strong enough to simultaneously supply the arc and to charge the condenser, the voltage at the arc will decrease. When it becomes smaller than the sum of the cathode drop and anode drop, the current will be extinguished. Then only the single circuit containing the condenser and the battery is left and the condenser is charged. Now the voltage at the arc will also increase again and if the cathode is still hot enough the arc will be started again. The condenser will then be discharged and so on. The high temperature of the cathode is of great importance.—*Phys. Zeit.*, September 1.

POWER.

Power Supply.—The first part of an illustrated description of the Willesden power house of the North Metropolitan Electric Power Supply Company. It forms now one of the two large stations of this company, but was originally built to supply current to the Willesden Urban District Council only. Direct current is distributed on a three-wire system to the nearby districts, while high-pressure, three-phase currents are transmitted to a large rotary converter sub-station in Kilburn. As the day loads are small and a single 300-kw machine is sufficiently large to deal with them for several hours of the day, the generators are of the double-current type, capable of supplying direct and alternating current simultaneously. The direct current is generated directly at a pressure of from 490 to 540 volts, suitable for the 2 × 240 volt network surrounding the works, while the average pressure at the alternating-current terminals is 316 volts. Transformers raise the pressure to about 2,850 volts, at which the current is transmitted to the sub-station. These variable-ratio, step-down converters reduce the pressure down to that suitable for the 2 × 240 volt, three-wire distribution.—Lond. *Elec.*, September 23.

New York.—STARRETT.—An article on power production and distribution by the New York City Railway Company, which has two power stations, one station serving seven sub-stations and one station serving three sub-stations. Power is transmitted at 6,600 volts. The general arrangement of switchboards is the same at both power stations. At each sub-station is a storage battery with a capacity of about 25 per cent. that of the rotary converter part of the plant. In charging these batteries a booster is used which raises the voltage of the sub-station bus-bars a maximum of 120 volts. In discharging the batteries float on the line. Particulars of both power stations are given. The coal consumption is 2.8 pounds per kw-hour. The efficiency of the whole generating and distributing system is 76 per cent.—*St. R'y Jour.*, September 24.

Electricity in Textile Mills.—ISAAC.—An illustrated article on the use of electricity in textile mills. Electric lighting has been generally adopted, one important result being the reduction of fire risks. Arc lamps are used for general illumination, while incandescent lamps serve for lighting different special machines. When electric power was first introduced, the electric motor was simply substituted for the steam engine driving a shaft, and the general arrangement of shafts was not changed. Later on individual driving of each loom by a special motor became more and more general, especially when the polyphase induction motor was introduced into the textile industry. This also resulted in a certain decentralization of the industry, since the advantages of individual driving encouraged weaving in private houses, special textures being made there, while the large plants produce the more common textures on a large scale. The author gives an illustrated description of motors for loom driving, made by the Allgemeine Elektricitäts Gesellschaft of Berlin.—*L'Electricien*, September 10.

REFERENCES.

Cost of Power Development.—SIMPSON.—An article on the cost of electric power from water under conditions specially favorable for the use of the power in electric ore-reduction works. He emphasizes that the case is quite different from that of ordinary electric lighting and power companies, and gives an estimate of the cost under ideal conditions.—*Electrochem. Ind.*, October.

Small Engines of Large Power.—ALLEN.—A brief article discussing special features of small engines of large power, especially the limitations set by the piston speed permissible, the difficulties resulting from the high frequency of ignitions, the disturbing effect of inertia and the gyroscopic effect.—Lond. *Elec. Rev.*, September 23.

Water Wheel.—RUSSELL.—Illustrated notes on some early forms of water wheels.—*Traction and Trans.*, October.

TRACTION.

Electric Traction Under Steam Road Conditions.—STILLWELL.—A discussion of the various factors which should influence the adoption of electricity for steam road conditions. The writer believes that 50,000 volts is perfectly satisfactory for transmission of power, so that a railway line 298 miles in length can be satisfactorily supplied from a single power station. The limit of trains which can be hauled by steam locomotives has now been reached, owing to the strain on the drawbars, couplings and in fact the entire car. Electric trains can be of any length on account of the multiple-unit system. The maintenance of the electric locomotive is less and the cost of labor is less. He then briefly considers the disadvantages of electric traction.—*St. R'y Jour.*, October 8.

Third Rail.—An editorial on guarding the third rail, with reference to various accidents which recently occurred on the Lancashire & Yorkshire and North Eastern Railways. Three classes of people are to be considered. First, if an ordinary person crosses the railway in defiance of the rules, the accident is not the fault of the third rail. Secondly, officials and porters at stations must often cross the lines; on such sections it is necessary to guard the live rail; but at complicated junctions and crossings and in stations and freight yards, the addition of a third rail may render matters so congested and reduce the space available to such an extent as to make it practically an impossibility to provide a guard for the live third rail. In such places the rail may be specially treated, possibly by employing some system which renders it dead, except when a train is passing over it. Thirdly, permanent way men consider it most desirable that the protection should be made removable in order to facilitate any repairs of the permanent way. But if it is made removable and is removed in the case of working on the line, it is, of course, of no use as a protection to these particular men. The writer expresses his firm belief that for ordinary lines the overhead single-phase system is the only one which will find general introduction on English railway systems.—Lond. *Elec. Rev.*, September 30.

Brakes.—DEWSON.—The first part of an illustrated article on the use of power brakes in electric traction. The primary cause of their introduction was the comparative degree of safety in operation of the cars, but another advantage is increased economy. Tests in both city and suburban service have shown that, of two cars, one equipped with air brakes and the other not so equipped, the hand brake car consumed from 10 to 15 per cent. more power than the air-braked car. This striking difference is due to the practice of motormen who have only a hand brake on which to depend, of keeping the brake shoes close to the wheels so that they may be able to make a quick stop when it is necessary and be confident of complete control of their car at all times. According to the source of power air brakes may be divided into the motor compressor type and the storage type; according to the manner of application of the air, into straight brakes, automatic and a combination of the two. For cars which operate singly and haul not more than one trailer, the straight air brake is generally used and it is, therefore, most common. The author describes this type.—*Elec. Club Jour.*, October.

REFERENCES.

New York Rapid Transit.—Four very extensive and profusely illustrated articles on the rapid transit system. Van Vleck describes the steam generating and engine equipment of the power plant, Stillwell deals with the electric generating equipment and the power distribution. A third article describes the new steel cars for the Subway and a fourth article the block signal and interlocking systems of the Subway.—*St. R'y Jour.*, October 8.

Mandalay.—An illustrated article on the recently opened electric tramway of Mandalay, which is the first city in Burma to substitute electric traction for horse traction. The length of the line is seven miles, double track throughout. The overhead equipment is on the span-wire system, double line of trolley wire being used throughout. There are 24 motor cars. The power house contains three direct-current, compound-wound, 200-kw generators, running at 400 r.p.m., the voltage being 500 to 550.—Lond. *Elec. Rev.*, September 30.

Mont Blanc.—ESPITALLIER.—An illustrated article on the proposed Mt. Blanc tramway, dealing especially with the mechanical difficulties due to the local conditions.—*La Nature*, October 1.

Interurban Cars.—BOYNTON.—An article on the general design and finish of the modern interurban car. A table is given of the dimensions of the present interurban car and standard American railroad coach of to-day and of three or four years ago. The body of the car is somewhat shorter, the platforms are longer and the car weighs about 25 per cent. less. The car is gradually approaching the steam railroad car in construction.—*St. R'y Jour.*, October 1.

Trucks.—COOK.—An illustrated article giving an outline of the main types of electric traction trucks now in use.—*Traction and Trans.*, October.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

South Africa.—A statistical article on the South African electrical industries with a two-page table on electrical supply and tramway

stations in South Africa, prepared by Poole. There are 12 lighting stations, of which three supply also current for traction and seven for power purposes, the latter amount being, however, relatively small. Four of the stations generate directly direct current at 440 to 500 volts for distribution on a three-wire system. Four stations generate single-phase, alternating currents at 2,500 volts, the frequencies being 50, 50, 62 and 100. One station generates both single-phase current for town supply and three-phase current for the suburbs, the frequency being 60 in the first case and 50 in the second case; the generated voltage is 2,000. Three stations generate three-phase currents, the voltage being 12,000, 3,300 and 2,000, the frequencies 50 and 60 and 50 respectively. The largest of these twelve stations has a capacity of 2,800 kw, while the smallest station has 100 kw. Five new stations are in progress, four of them using direct current, the fifth single-phase, alternating current. Seven stations supply tramway systems, the trolley system with 500 to 550 volts being used in all cases. It is stated that there are wide fields for development. Towns with populations of 1,000 and upward which were scarcely heard from before the late war are now opening works or being granted concessions for electricity undertakings. Gas works are confined to four towns, and no such restrictive regulations as in England limit the progress of electrical engineering. The industries, apart from mining, are still of a very limited nature and the labor question is very troublesome. Electric cars are now coming into use at the harbors. Most of the main line trains are lighted electrically. The electrification of the railways is as yet a suggestion; the first section to be so equipped is most likely the new line running the length of the Witwatersrand Reef. Farther north to the Zambesi there are immense possibilities for electricity works. This district is the only one in South Africa where water power may be made use of on anything like a large scale. In Natal there are two water power transmission plants. In British Central Africa the civil authorities at Zomba have a small water power plant for the lighting of the officials' bungalows. With the development of the mining industries of the Rand and Rhodesia large demands for machinery are expected, the present tendency being to centralize the electric generating stations instead of erecting many small and scattered plants. Examples of this tendency are at Brakpan and the Rand Victoria. Electric haulage has not yet been put into use on anything like a large scale, but on the deep level mines a field for development is certain. The Village Deep are just equipping a light tramway operated by electricity in one of their levels. The applications to pumping and coal cutting are becoming very common. The air drill still holds sway in spite of the great inefficiency of transmission from the compressors. Telegraph and telephone industries are very active just now.—Lond. *Elec. Rev.*, September 30.

Sub-Station.—An illustrated description of the sub-station which the Company of Eastern Railways has recently put into operation at the Batignolles Station, near Paris, for the purpose of supplying power and light to various passenger and freight stations. Three-phase, 5,000-volt currents are transformed into direct current of 500 volts by means of two 600-kw and one 300-kw induction motor-generators. A storage battery of 1,000 amp.-hours has been installed to secure continuity of service during any disturbance which might occur in the high-pressure line. The energy is distributed on the three-wire system, so that at the places of utilization the voltage is 220 on each side of the neutral wire, which is connected to earth. The station also contains a 100-kw balancing set, running at a speed of 550 r.p.m., and consisting of two rigidly coupled generators excited from the opposite sides of the system.—Lond. *Elec. Rev.*, September 30.

REFERENCES.

Automatic Switch for Transformers.—SCHMITT.—A long illustrated description of a switch for disconnecting transformers from the line, in order to prevent the energy loss at no load. This article refers especially to the case in which the transformers are connected both primarily with the high-tension network, and secondly with the low-tension cable network. In this case it is necessary to disconnect both the primary and secondary windings. The switch consists of two parts, the switch proper and the operating relay. For the latter the same regulating device is used as for regulating alternating-current differential arc lamps. The construction is described in detail and illustrated.—*Elek. Zeit.*, September 15.

Rules and Regulations.—A set of rules concerning the rating, installation and tests of electric generators and transformers, adopted by the Associations Françaises de Propriétaires, the Association des Industriels du Nord de la France and the Association Normande.—*L'Elec.*, September 17.

Insulator Pins.—An illustrated article on a number of malleable-iron pins for high-tension work.—*St. R'y Jour.*, October 8.

WIRES, WIRING AND CONDUITS.

Calculating Electric Lines.—ROSENBAUM.—A mathematical article on the problem of calculating a network, for which the loss or the efficiency are given for predetermined voltages in the generating station and at the consumers' premises, while the cross-section of the wires and the voltages in the branches of the network are to be determined. The exact calculation leads for n branches to equations of the n'th degree. The author describes three approximate methods which are based on the same principle; this consists in eliminating the branch voltages and cross-section from the equations and in calculating the unknown values by introducing simple approximate equations. A numerical example is added.—*Zeit. f. Elek.* (Vienna), October 2.

ELECTRO-PHYSICS AND MAGNETISM.

Radioactivity.—LORD KELVIN.—A paper giving a plan of the combination of atoms to have the properties of polonium or radium. The properties to be explained are: to store a large finite amount of energy in a combination having very narrow stability; and to expend this energy in shooting off with very great velocity, vitreously and resinously electrified particles. His plan for the structure of polonium may be briefly described as two void atoms held together against their mutual repulsion by a bond consisting of one electron. His plan for the molecular structure of radium may be described as two electrons held together against their mutual repulsion by a bond consisting of one void atom.—*Phil. Mag.*, October.

Torque in Alternating Magnetic Field.—AXMANN.—If a rod or wire, D (Fig. 2) of soft iron is placed in the field of an alternating-

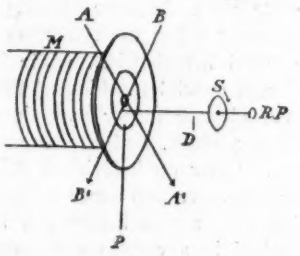


FIG. 2.—TORQUE IN ALTERNATING FIELD.

current magnet, M, as nearly as possible parallel to the lines of force, and preferably in a horizontal position, and if the one end of D comes near the pole P, but does not touch it, while the other end, $R P$, is fixed, a peculiar torque is observed, which may be transmitted to other bodies fixed on D; for instance, a circular disc of pasteboard, S. When the current is closed the disc begins to rotate with high speed, namely, in a direction opposite to the hands of a clock when the rod, D, is passed with its free end in the direction $A A'$, and the disc rotates in the opposite direction for the direction $P P$ of the rod. "The cause may be found in oscillations of the rod D, which produce the effects according to the period of the alternating current, perhaps under simultaneous influence of gravity."—*Phys. Zeit.*, September 1.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Potassium Chloride and Sodium Chloride.—WINTELER.—A discussion of the essential differences which exist in practice in the electrolysis of potassium chloride and sodium chloride. In the first place commercial common salt is never pure, while pure potassium chloride may be had in trade. Common salt contains on the average one per cent. of magnesium chloride and one per cent. of sulphuric acid, bound as sulphate. The content of magnesia is advantageous for manufacture of chlorates since it raises the efficiency of the process; on the other hand, for the manufacture of caustic soda, the use of a diaphragm cell is unsuitable, since the content of magnesia causes the diaphragm to be clogged, because in the diaphragm magnesia is deposited. The content of sulphate causes the sodium chloride electrolysis to change gradually into a sulphate electrolysis, resulting in the destruction of the carbon anodes as well as of the diaphragm. On the other hand, for the electrolysis of

potassium chloride a diaphragm cell is perfectly suitable. The author then discusses the differences in solubility of potassium chloride and sodium which cause differences in the process of evaporating the salt solutions whereby potassium chloride must be separated from caustic potash and caustic chloride from caustic soda. The author finally discusses the differences in the electrolytic production of potassium chlorate and sodium chlorate.—*Electrochem. Ind.*, October.

REFERENCES.

Platinum Anodes.—TOMMASI.—An account of experiments showing that in highly concentrated solutions of hydrochloric acid platinum, when used as anode, passes into solution. In less concentrated solutions platinum does not dissolve at all.—*L'Elec.*, September 10.

Training of Chemists.—RAMSAY.—His presidential address before the Society of Chemical Industry on the training of technical chemists. He emphasizes that the education should consist in an effort to produce an attitude of mind rather than of instilling definite knowledge.—*Electrochem. Ind.*, October.

German Chemical Industries.—A statistical article on the German chemical industries.—*Trac. and Trans.*, October.

Ferro-Alloys.—SCHOLL.—A continuation of his article on the manufacture of ferro-alloys in the electric furnace. In this installment he deals with the manufacture of ferro-silicon.—*Electrochem. Ind.*, October.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrodynamometer.—BRUGER.—An illustrated paper read before the Berlin Electrical Society. He first discusses the general principles which must be fulfilled in order to obtain a uniform scale for an elec-

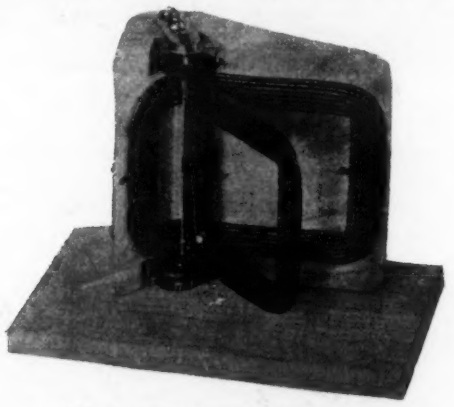


FIG. 3.—ELECTRODYNAMOMETER.

trodynamometer. If the mechanical force which acts on the needle and counteracts the electrodynamometer effect is directly proportional to the angle of deviation (for instance, in the case of the torsion spring), the electrodynamic force must be inversely propor-

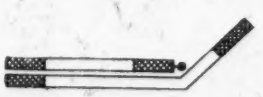


FIG. 4.—CROSS-SECTION OF ELECTRODYNAMOMETER.

tional to the angle of deviation. He discusses at some length how this may be accomplished. In the instruments which appear to be the most suitable ones for the practice the two coils are arranged as shown in Fig. 3 and in cross-section in Fig. 4. In this case the scale is nearly perfectly uniform between 2 and 65 milliamperes. The smaller coil, in form of a square is movable, while the larger rectangular coil is bent around the axis of the rotation, as clearly seen in Fig. 4. Both coils are very shallow with few windings side by side and with many windings above each other.—*Elek. Zeit.*, September 15.

Electrochronograph.—OWEN.—An illustrated description of a new electrochronograph, devised so as to be capable of automatically recording the time of a 100-yards flat race with an accuracy well exceeding that of a stop watch, say, to the hundredth part of a second. A cylindrical drum is revolved uniformly; supported parallel to its axis is a guide rod, consisting of a tube, within which is a leading screw driven through gear wheels from the drum. Geared to this leading screw is a transmitter which carries a brass frame on which is mounted an electromagnet. The pivoted armature of the magnet is provided with a steel needle acting as a style which, when the magnet is excited, presses on the surface of the drum, leaving it when the circuit is broken. The drum consists of an inner cylinder over which fits just tightly an outer hollow cylinder, which is, therefore, readily detachable. The outer cylinder has a smooth surface, which is thinly coated with soot. It will thus be seen that when the apparatus is in motion the style if pressing on the drum will trace a fine spiral line. The two important points are: First, uniformity of running of the drum, which is secured by use of a centrifugal governor, and, second, a means of accurately determining the time of one revolution. The latter is obtained by putting the electromagnet in connection with a clock pendulum and a sounder.—Lond. *Elec.*, September 30.

Condensers.—LOMBARDI.—A paper presented to the Italian Electrical Society giving an account of his continued efforts to construct commercial high-tension condensers. He states he has not yet been able to overcome all difficulties. He first experimented with insulating materials of the paraffin group, but found that commercial white wax, though more expensive, is more suitable on account of its higher melting point and its general mechanical and dielectric properties. He now uses mixtures of paraffin and white wax. To obtain very thin and absolutely homogeneous films of the insulating material, with perfectly parallel surfaces, he employs the following method: The fluid insulating material, at a temperature a few degrees above its melting point, is spread over a bath of mercury, carefully maintained at the desired temperature. When the layer solidifies it is removed from the mercury and placed on a glass plate. The method is stated to be very successful. The mercury bath may be used over and over again for an apparently infinite number of times, since its surface remains absolutely clean. Plates of a thickness of 1 mm., if perfectly homogeneous, stand for a short time voltages of 30,000 to 35,000 without being perforated. Plates of 2 mm. thickness stand 50,000 volts.—*L'Elec.*, September 24.

REFERENCE.

Testing of Cables by Röntgen Rays.—OTTO.—An illustrated description of a Röntgen ray apparatus for testing submarine cables, in order to verify the exact central position of the core in the cable and to detect any faults or impurities in the insulation.—*L'Elec.*, September 17.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Measurement of Wireless Telegraphy Waves.—FLEMING.—His British Association paper in full on the propagation of electric waves along spiral wires, and on an appliance for measuring the length of waves used in wireless telegraphy. The general method of the author has already been noticed in the Digest. The author remarks that in the construction of inductances and helices for his method, they should be wound on ebonite and not on wooden cores. Spirals of wires, if the turns are at all close, have less inductance for frequencies of the order of a million than for frequencies of the order of 100, on account of the dielectric current passing between the turns. The best form to give to a standard of inductance for high-frequency work is a single wire bent into a circle or a square. The velocity of an electric wave along a closely wound helix of wire is measured by the reciprocal of the square root of the product of its capacity and inductance per unit of length. The distance from the open end of the helix to the first node is always much less than a quarter of a wave length, in fact nearly one-fifth of a wave length. The distance between the first and second nodes reckoned from the free or insulated end of the helix is one-half of a wave length. If the fundamental oscillation is set up in a helix by attaching one end to an oscillating circuit tuned to it, the wave length is rather more than four times the length of the helix, but not five times.—*Phil. Mag.*, October.

REFERENCES.

Manufacturing Plant.—HEWETT.—A long and fully-illustrated description of the Pittsburg Works of the Westinghouse Company.—*Traction and Trdns.*, October.

Copper.—RICHARD.—The first part of an illustrated article on the copper mines of the Lake Superior region. During 1903 the traffic passing the Sault Ste. Marie on the waterway amounted to 34,674,437 tons, of which 21,654,896 tons were iron ore and 112,877 tons copper. The author gives an outline of the geographical situation of the copper region and of the condition of the miners. Among the workmen of the Calumet and Hecla copper mine 38 nations are represented.—*Eng. & Min. Jour.*, October 13.

Fire Alarm.—MIRAM.—An illustrated article on electric fire alarm devices for store houses and theatres.—*Elek. Zeit.*, September 15.

The Water-Wheel Equipment in the Puget Sound Power Company's Plant.

BY GEORGE J. HENRY, JR.

AT the time the order was placed for Pelton water-wheel apparatus for this very interesting installation, illustrated and described recently in ELECTRICAL WORLD AND ENGINEER, there were no tangential wheels in operation anywhere in the world, driving anything larger than 2,000 kw. The problem presented for this plant was to equip the initial installation with four direct-connected units each driving a 3,500-kw General Electric generator at 225 r.p.m., the water wheels to operate under an effective head of 865 ft.; also two Pelton exciter water wheels, each driving a 150-kw exciter at 600 r.p.m. The problems involved in designing the wheels for this installation were largely new; not that wheels had not been built for satisfactorily withstanding higher pressures, as numerous Pelton wheels are in satisfactory operation up to 2,200 ft., but that the enormous strains coming on the buckets and wheel rims were vastly greater than anything that had before been attempted in this line. The strain on the shaft and bearings was also known to be well above all recognized practice. The topography of the ground on which the power house was to be located was such as to make it necessary to maintain a minimum width of building, otherwise the amount of excavation necessary would have been enormously expensive.

The ultimate installation, as has been noted, is to consist of eight

FIG. 1.—VIEW OF INTERIOR OF STATION.

units, and the entire equipment is so arranged as to provide complete pilot control of the water wheel apparatus as well as electric. This is accomplished from the switchboard which is arranged at one end of the building, and the complete eight units, the ultimate proposed capacity, will require a building length considerably over 200 ft. long. It was, therefore, necessary to keep down the length of each unit as much as possible, and for this reason, among others, it was decided to employ the Pelton two-bearing, double-wheel overhung type of construction. This was arranged with one water wheel on each end of the main shaft, this construction enabling the bearings to be more equally loaded than if the entire output was placed on one water wheel. The fractional load efficiency is also better, and the regulation very much closer than would be obtained if a single nozzle and wheel were employed to develop the entire output, for each unit. Each main unit and exciter is supplied by a separate pipe line conducting water from the balancing reservoir at the inlet end of the flume line.

The contract with the Pelton Water Wheel Company for the hydraulic equipment commenced at the terminals of these four main pipelines and that of the exciter line, and beginning at this point is located a heavy cast-steel Y pipe. This is cast with extra large ribs and with heavy flanges. Each is faced and recessed for suitable rubber gaskets. Each branch of this Y pipe feeds to a 24-in. inside diameter, connecting pipe flanged to match the inlet of main gate valves. The supply for each of the eight Pelton water wheels is furnished through a 24-in. cast-steel, specially designed gate valve, as illustrated.

The main bodies of these gates are located below the floor line,

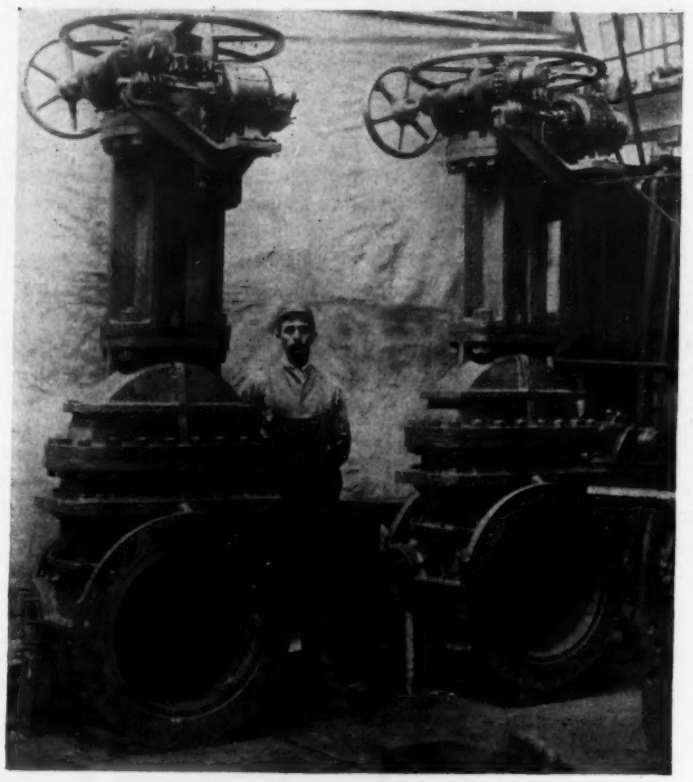


FIG. 2.—CAST-STEEL MAIN WATER WHEEL GATES.

the yoke and gearing projecting well above to enable the gates to be readily handled by hand from the main floor if necessary. The main screw consists of a nickel-steel stem threaded with four left-hand square threads per inch, running in a phosphor-bronze nut.

FIG. 3.—ONE OF THE MAIN WHEELS.

Loosely threaded to this nut is a 36-in. polished rim hand wheel with clutch mechanism. This hand wheel is to enable the gate to be quickly opened when the pressure is equalized on each side of the main gate disc by the use of the by-pass. Suitable gearing is arranged so that the gate may be started on its seat under the full

working pressure by an auxiliary hand wheel, shown in the illustration. An electric motor control with suitable switching mechanism from the main switchboard is also provided for operating the valve.

There is mounted on the main gate stem a cut-out to enable the motor to be automatically cut out at each end of the stroke without interfering with the return connections and the motor being reversed the cut-out is again automatically cut in.

The gate seats are made very heavy, of the highest grade phosphor-bronze, faced and ground in place. They are readily renewable, as

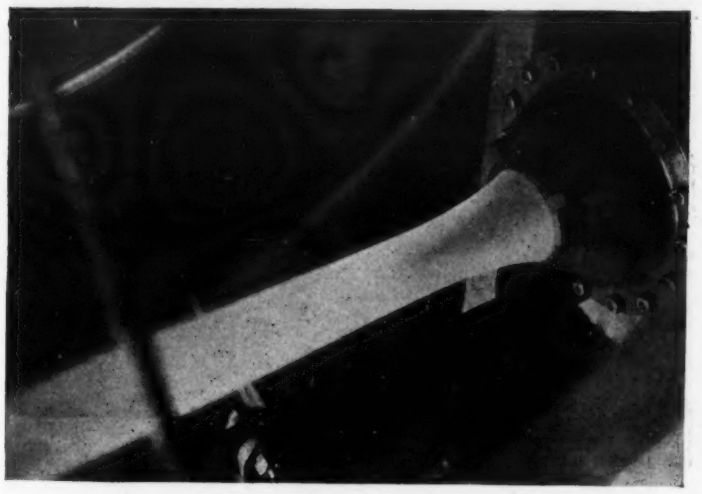


FIG. 4.—NEEDLE NOZZLE STREAM.

are also the gate discs, should this become necessary. There is arranged for each gate a 5-in. by-pass of similar design throughout, the hand wheel for operating this projecting above the main floor line. By closing the needle nozzle and opening the by-pass, pressure is equalized around the main gate valve, which can then be very easily and quickly opened, or the main gate may be controlled entirely from the switchboard by the electric motor drive, clearly shown in Fig. 2. The enormous pressure on the nut, this being over 200,000 pounds, is taken up in each direction by a suitable oil packed steel roller bearing. These are arranged on each side of the bronze nut collar. The nickel-steel gate stems are provided with suitable bushings to be packed under full working pressure, thus reducing the likelihood of having to empty the main pipeline to a minimum. The outlet flanges of these main gates are connected to the inlets of the ball and socket jointed nozzle, one nozzle being provided for each water wheel. A small curvature is introduced in these nozzles to serve the double purpose of an elbow, which is necessary to reach the water wheels from the Y, and to provide a suitable outlet for operating stem of the needle.

The deflecting nozzles are of very substantial proportions, having 24-in. inside diameter inlet flanges and tapering slightly to the tips.

FIG. 5.—NICKEL-STEEL HOLLOW SHAFT.

The ball joint is polished and provided with sole leather packing. The trunnion pins are each set in oil-packed phosphor-bronze bushings and are of fluid compressed nickel-steel turned and polished. Supports are provided on each end of the trunnion pins, one end setting in an axial recess in the ball and the other end supported by a heavy forged steel strap. This is securely keyed and bolted to the body of the nozzle. The swinging portion of the nozzle weighs approximately 5,000 pounds and is counterbalanced by a suitable bronze-lined controlling hydraulic cylinder with leather-packed piston receiving pressure from the main pipeline. The nozzle tip is flanged and bolted to the terminal of the nozzle taper pipe, and turned true and polished on the inside surface to curves of least resistance. The needle itself is cast hollow and of gun metal, and turned true and polished to make the smoothest possible surface over which the water flows.

The accompanying engraving (Fig. 4) shows the character of stream obtained from one of these nozzles. This cut also clearly shows the blur occasioned by the rotating wheel center and buckets during the exposure of the photographic plate.

The needle is threaded to the end of a heavy nickel-steel rod, which is carried in a suitable grease-packed bushing and is supplied with bronze-bushed bearings. The water pressure against the needle is balanced by helical steel springs, which may be adjusted to the different sizes of tips or to wear. The position of the needle may be readily adjusted by a hand wheel actuating cut gears and forged steel connections to the needle stem.

It will be noticed that the power developed on each wheel may be controlled in two different ways: First, by deflecting the nozzle, thus varying the quantity of water which impinges on the wheel, and second, by varying the flow of water through the nozzle by adjusting the position of the needle above mentioned. The hydraulic governor is arranged for controlling the speed automatically by moving the deflecting end of the nozzles. It will be noticed that this in no way varies the velocity of water flow in the main pipeline, and therefore cannot possibly occasion any water hammer. This is a point of the utmost importance in obtaining accurate regulation, especially under high pressures and when using long pipelines. This form of regulation is much superior to that obtainable with turbine wheels for this very reason.

The adjustment of the position of the needle can be accomplished

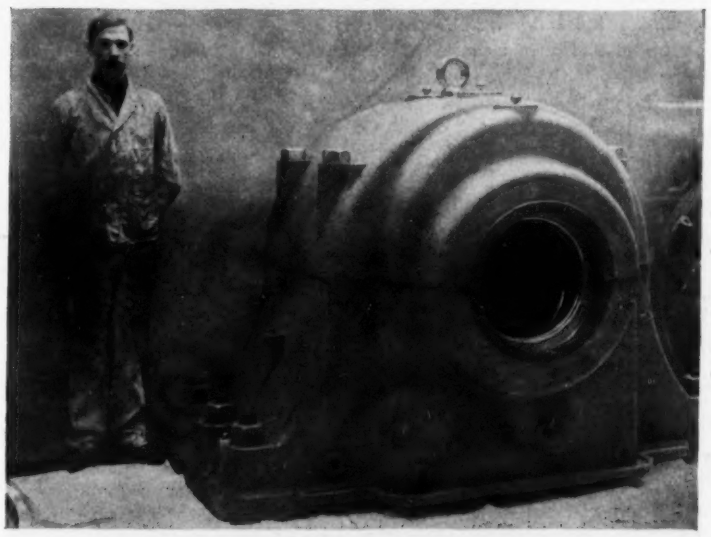


FIG. 6.—PELTON GENERATOR TYPE BEARING.

as often as required in order to allow for the peak load, which is likely to occur during any hour of the day or during different periods of the year, such as holiday loads on the interurban railroads. This hydraulic governor is arranged between the main gate valves and nozzle, and a suitable rock shaft, and the gear connections control the pair of nozzles for each unit. The governor is driven by belting from the main shaft.

The wheels, two in number for each unit, are pressed one on each overhanging end of the nickel-steel shaft. They are 9 ft. 10 in. in diameter, and each wheel is fitted with a set of cast-steel annealed buckets ground to true interior surfaces and milled and drilled to United States standard gauges to fit the rim of the main cast-steel wheel center. Buckets and centers are carefully adjusted to an exact weight and to a running balance, and each bucket is securely bolted to the wheel rim, with two fluid compressed nickel-steel bolts provided with hexagonal semi-finished nuts. Buckets are spot-faced where the nuts seat upon them and all milling and drilling and reaming is done to United States standard gauges and jigs.

The main shaft for each unit is made from highest grade fluid-compressed nickel-steel, forged hollow, annealed and bored out. The shaft is turned to 14 in. diameter at each end and to 20 in. in diameter where fitted with the General Electric rotor between the journals. The journals are 16 in. in diameter and are supported by a babbitted surface 48 in. long. The journals are polished and oil guards are arranged on each end with a liberal right angle surface

bearing on a suitable babbitted projection to take up any end thrust that may occur due to the machine getting out of magnetic balance or alignment. The General Electric rotors were pressed onto the main shaft with a pressure of about 150 tons, and each water wheel was pressed on with a pressure of between 90 and 110 tons.

The bearings are of the Pelton generator type of construction, with heavy machined ball and socket joint and provided with Finn's armature metal, bored out and scraped and each supplied with four heavy bronze rings. In addition to this special oil grooves are cut in both the top and bottom halves of the bearing, which are further doweled together. There is a special high-pressure oil groove not connecting with any of the others. This is located vertically under the axis of the shaft, and connection is made to this by flexible high-pressure oil pipe from a motor-driven, high-pressure oil pump supplying oil at 2,000 pounds per sq. in. It is only necessary to use this pump in starting the wheels in order to avoid damaging the babbitt surface, as the rotating element weighs in excess of 98,000 pounds. So nicely is the entire rotor balanced that a man's weight on one of the buckets will readily turn the entire shaft when the high-pressure oil is turned on. In addition to this, there is provided a centrifugal oil circulating system so that the bearings may be flooded with a large additional amount of cool oil if the least heating occurs.

There is also a set of water cooling connections arranged to a grilled water compartment next to the babbitt surface, so that a maximum amount of heat may be removed by the cooling water. In each bearing a pair of thermostats is connected in parallel in a suitable electric circuit for indicating at the switchboard a dangerous temperature rise in any of the journal bearings. The water wheel is encased in a sheet-steel cover housing matching the heavy cast-iron lower housing, which in turn is carried on a massive cast-iron bed plate. This bed plate is provided with water grooves and extends beneath the engine type generator, which it also supports, thus making one bed plate for each generator. Polished brass hand rails are supplied around each generator and heavy sheet steel grilled floor plates are provided over the nozzle gate and rock shaft compartment for each unit. The removal of these plates permits access to the various pressure connections and enables all of the heavy parts to be readily handled with the power house 50-ton electric crane, which is arranged to travel the full length of the building.

There are two exciter units, either one capable of exciting six of the main generators. These are driven by a special 38-in. Pelton wheel supplied with water through a combination needle and deflecting nozzle, and the wheel is encased in a heavy cast iron and sheet steel housing and carried on a suitable cast-iron bed plate, which is also arranged to carry the exciter and inductor motor.

The highest grade of material and best possible machine work were

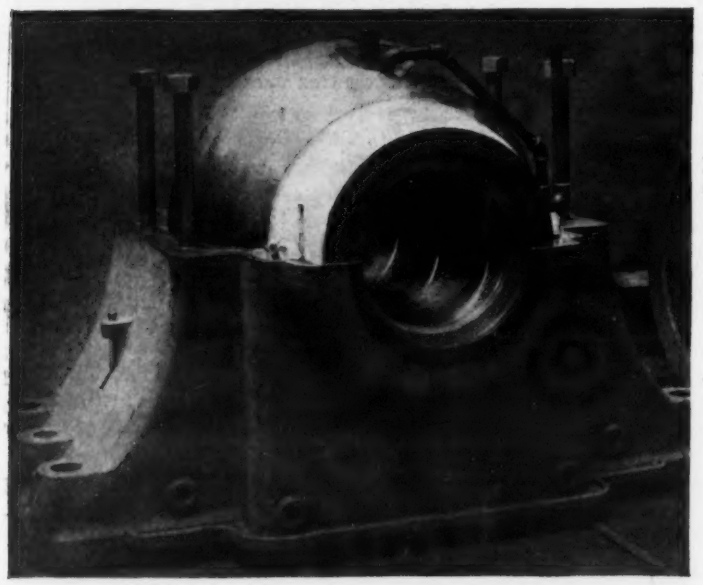


FIG. 7.—BEARING PARTLY ASSEMBLED.

furnished throughout on this plant, which has now been in operation for some time past. No shutdown of any kind has been occasioned by the hydraulic apparatus, although each unit is guaranteed to operate at 7,500 hp, and has in practice carried loads in excess of that amount. The plant is operated 24 hours per day, and owing to the obstacles encountered in the design and installation it is certainly a credit to Messrs. Stone & Webster, of Boston, as well as the others engaged in the design and actual construction work, as the entire project has been carried through to a successful issue in the remarkably short period of 16 months, the first water wheel unit being put in continuous operation in exactly one year from the signing of contract.

The entire hydraulic equipment from the terminal flanges of the pipelines to the engine type generators, including all the governing

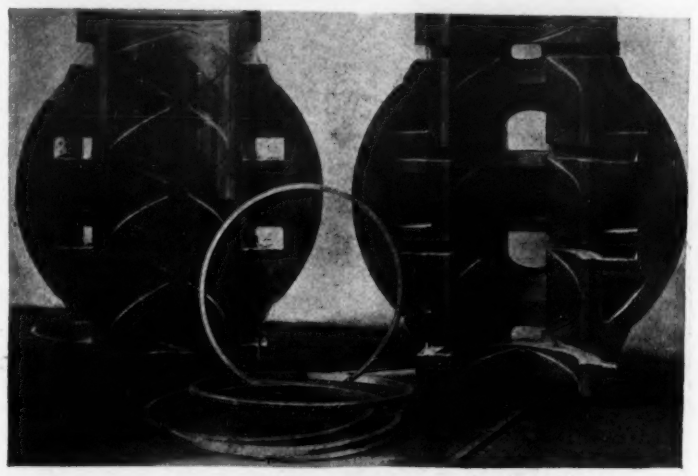


FIG. 8.—BABBITTED SURFACES OF BEARINGS.

apparatus, shafts, bearings, bed plates, etc., were designed, manufactured, erected and put into operation in the power house by the Pelton Water Wheel Company, of San Francisco.

Tests of samples taken from fluid-compressed hollow forged nickel-steel main shafts are as follows:

Shaft.	Tensile strength.	Elastic limit.	Per cent. extension.	Per cent. contraction.
1	81,490 lbs.	53,980	28.5	56.44
2	80,970 lbs.	50,420	29	59.79
3	80,970 lbs.	50,420	27	60.3
4	80,470 lbs.	50,930	26.5	50.14
Requirements	80,000 lbs.	50,000	25	45

Tests of nickel steel rods follow: tensile strength, 95,000, 102,000; elastic limit, 65,000, 65,500; Extension, 23%, 24.2%; Contraction, 53.9%.

A Water Power Exhibit at St. Louis.

Among the exhibits in Machinery Hall at the World's Fair in St. Louis is one which is an operating example of small capacity to

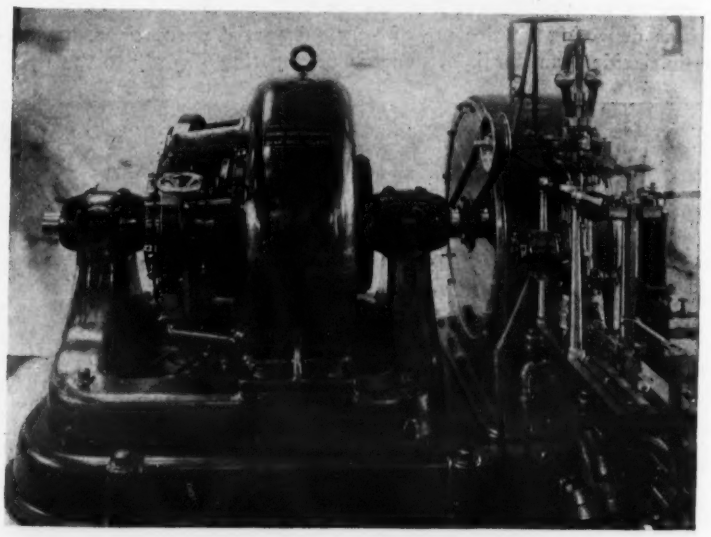


FIG. 1.—WATER POWER EXHIBIT.

illustrate the way in which electric current is generated in high head water power plants on the Pacific Coast of the United States, in the Rocky Mountains, in Mexico and wherever high heads of water are available. Since there is, of course, no high head water at the World's Fair, the only way to show such a plant in operation

was to combine it with a high lift pump to furnish the necessary pressure water.

The joint exhibit represents the co-operative work of seven individual manufacturing and engineering concerns and consists of a steam-driven mine pump furnishing water under 300 pounds pressure to a tangential water wheel, the latter being directly connected to a railway generator furnishing direct current of 550 volts into the network of the Intramural power plant. The mine pump and water wheel are for the first time shown in active operation at a universal exposition.

The speed and output of the water wheel generator are regulated by a needle nozzle, the latter being directly operated by an hydraulic governor. In case of light load the surplus water furnished by the pump is taken care of by a by-pass terminating in a relief valve.

Provision has been made to demonstrate and keep on record during the entire time of operation the high efficiency of the tangential water wheel by specially tested indicating and recording instruments. A Venturi meter with register and manometer indicates the quantity of water delivered to the wheel and a Metropolitan recording pressure gauge the pressure of the water, including the losses in the nozzle and its connections to the Venturi meter.

The speed of the water wheel generator is shown by a shaft tachometer. The latter is driven without a belt and therefore belt-slip and incorrect indicating are avoided.

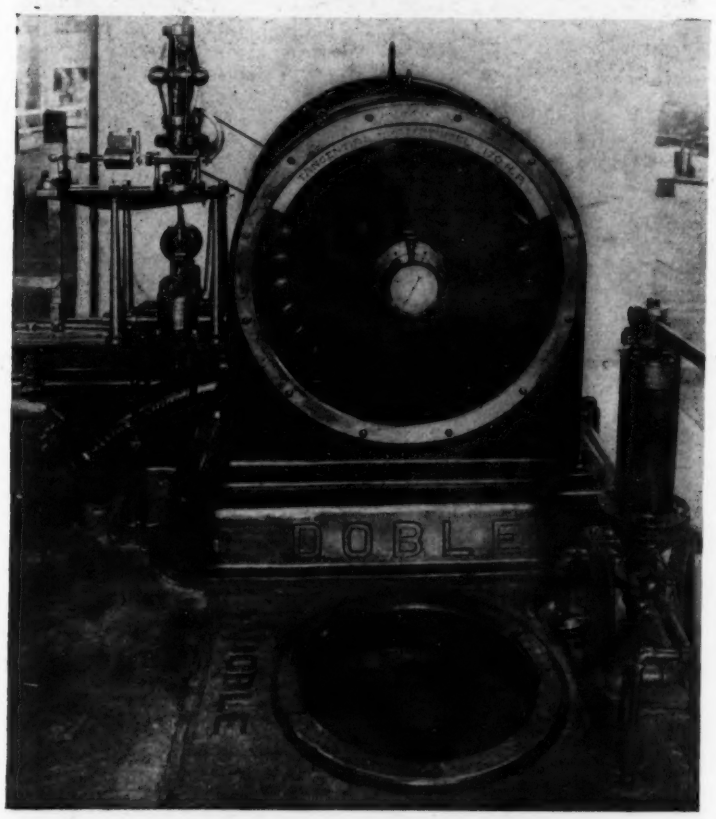


FIG. 2.—WATER POWER EXHIBIT.

It need hardly be mentioned that in practical installations tangential water wheels draw the water from natural falls through a pipeline, the friction in the pipeline and gate valves being the only losses to be added to arrive at the total efficiency of the high-pressure hydro-electric power plant. The efficiency of a pipeline in commercial plants ranges from 90 to 95 per cent., the combined efficiency of a high-grade water wheel generator from 74 to 82 per cent., according to load; the total efficiency of a high-pressure hydro-electric plant thus ranging from 74 to 78 per cent.

The exhibitors in the group are as follows: Jeanesville Iron Works Company, Hazleton, Luzerne County, Pa., duplex triple expansion condensing mine pump for a lift against 700 ft. and a capacity of 1,200 gallons per minute. Abner Doble Company, San Francisco, Cal., tangential water wheel with ellipsoidal buckets and needle regulating nozzle developing, under a head of 700 ft., 170 hp maximum at 700 r.p.m. Crocker-Wheeler Company, Ampere, N. J., railway generator, 550 volts, 700 r.p.m., rated capacity 100 kw. The Lombard Governor Company, Boston, Mass., type J governor operating Doble needle nozzle directly, balanced relief valve. Builders' Iron Foundry, Providence, R. I., ten-inch Venturi meter with register and manometer. The Schaeffer & Budenberg Manufacturing Company, New York, N. Y., shaft tachometer; Metropolitan recording pressure gauge.

Silvey Storage Battery.

The accompanying illustrations show the construction of the Silvey storage battery, made by the Dayton Manufacturing Company, of Dayton, Ohio. The grids are cast from lead containing a considerable percentage of antimony, this, it is claimed, making it practically impossible for the plates to warp or buckle. After the grids are pasted and the plates hardened by a special process, they are assembled into elements by means of 2½-in. lead bolts. The horizontal plates are rigidly held in place by means of hard lead nuts, which are run down the bolts as the plates are added to the pile. One bolt joins all the positive plates and the other bolt the negative plates. After the elements are assembled the nuts and edges of the plates are electrically welded. Two sheets of porous separating material are placed between each plate, and these separators hold about seven-eighths of the acid required during the normal discharge of a battery, so that in case a jar is broken the battery continues to discharge.

FIG. 1.—PLATE OF CENTRAL STATION CELL.

In the horizontal-plate type the active material does not fall out nor can it be forced from the plates by the action of the gases which are given off when the battery is at work. For this reason the battery, it is claimed, retains its normal capacity for many years. Round glass jars are used, since they are considerably stronger and more uniform than rectangular jars, and they can be purchased for about one-third the cost of rectangular jars of similar capacity.

This method of construction has been used by this company for the last fourteen years in the manufacture of train lighting cells,

of which it has sold nearly half a million dollars' worth of cells in rectangular hard rubber jars.

Fig. 1 is an illustration of a positive plate removed from a 5,000-amp.-hour central station cell, after having been in service for two years. Very thin ribbon strips are pasted on both sides with the active material used in pasted plates. The strips are rolled up into plugs and are inserted and swedged into the holes, which are spaced at regular intervals over the surface of the hard, cast-lead grid.

The plates are not placed in nitric or other similar acid, in order that the lead ribbon may be attacked and rendered porous, as the process of removing the nitric acid by washing and charging is regarded as difficult and uncertain. Instead the plates are placed in an ordinary sulphuric acid electrolyte and the active material or paste in the plugs forms in the usual manner. Due to the electrochemical action the ribbon, in a short time after the battery is placed in service, becomes active and the battery continues to increase in capacity. Plates constructed in this way are almost indestructible, provided the battery receives reasonable care and attention.

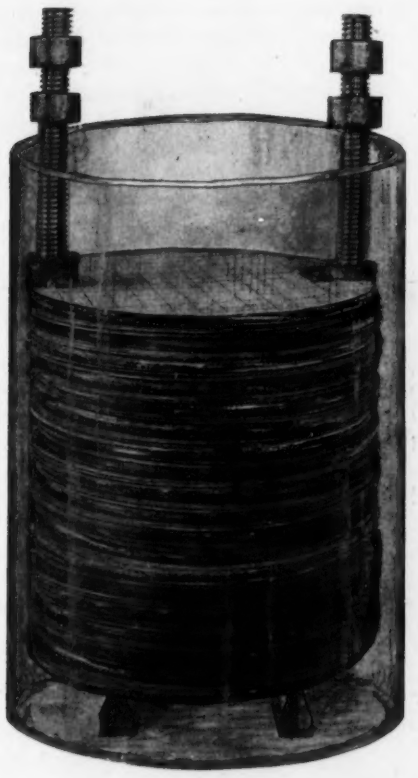
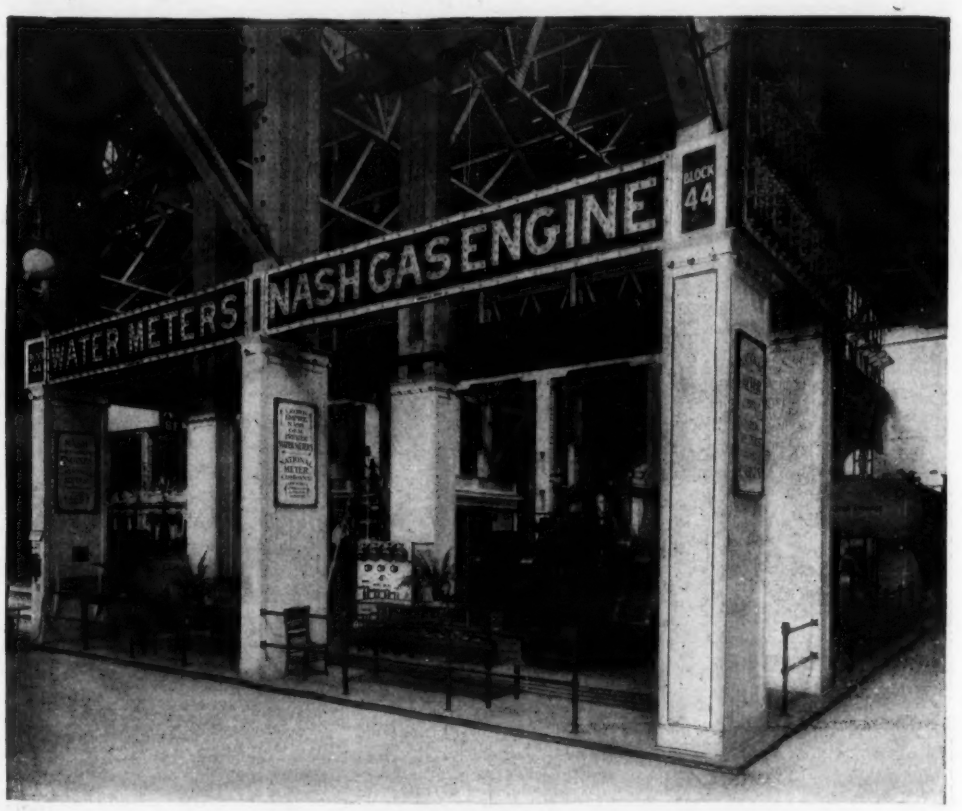


FIG. 2.—BATTERY WITH HORIZONTAL PLATES.



NATIONAL METER COMPANY'S EXHIBIT.

Exhibit of the National Meter Company at St. Louis Exposition.

The National Meter Company, of New York, Chicago and Boston, has an exhibit at the Louisiana Purchase Exposition which is of unusual interest from an electrical standpoint. In addition to a complete line of the five types of its water meters it shows three sizes of Nash gas engines direct-connected to C & C generators. All of these are in constant operation and the largest unit generates all the current required for the brilliant illumination of the exhibit itself. These, and two engines direct-connected to pumping outfits, are run with gas obtained from producers built by R. D. Wood & Co., Philadelphia. The 20 and 30-hp units are of regular double-cylinder, vertical pattern, while the 150-hp unit is of the three-cylinder type. In these combinations both engine and generator are mounted on one bedplate, thereby forming a compact and self-contained lighting unit, especially noted for the limited space occupied. The smallest of these machines, which occupies a floor space of 5 x 7 ft., and is 7 ft. in height, is capable of supplying 200 lamps of 16 cp at 110 volts. The largest size has a capacity of 1,500 lamps and requires a floor space of 6½ x 17 ft., and its height in the clear is 10 ft. A special feature of this system is found in the fact that, while one base is common to both, the engine and dynamo are not rigidly united. The coupling serves as a regulating device to correct any tendency of the dynamo to follow the engine in such variations in speed as occur during a cycle, or because of changes in the load. This elastic compensation is so thoroughly effected that the generator maintains a practically unvarying speed, and, therefore, produces a light so steady that the eye is unable to detect any flickering in the lamps, while the fluctuations of the voltmeter are almost imperceptible in ordinary working, and are insignificant under changing loads.

It is evident that such close regulation, in conjunction with marked economy and reliability of operation, provides a plant having unusual merit. The general plan of illumination is well and clearly brought out in the engraving. Upon each of the four sides of the space occupied by the exhibit are signs formed of raised letters, each of which is outlined with incandescent lamps. Rows of lamps border each sign, and around the tops of the columns marking the space are additional lamps for general illumination. The effect is both striking and pleasing.

The gas producer is designed to have both a continuous and an automatic feed. Not only is this accomplished, but the coal is distributed evenly over the entire gas-producing surface. An uneven thickness of a bed of fuel means gases varying in composition at different parts of the bed, and the excess of carbonic acid and other inert gases generated means a waste of fuel. A revolving grate in a closed ashpit provides for the easy removal of cinders without admitting a rush of cold air. A deep bed of fuel is carried upon a deep bed of ashes, both of which features add to the quality and quantity of gas produced.

Water Storage System at St. Louis Exposition.

The apparatus exhibited by the Acme Water Storage & Construction Company, in Block 44, Aisle 9, Machinery Building, at the St. Louis Fair, is intended to make possible the constant supply of water under high pressure, as, for instance, for tall buildings, country residences and small municipal water works, displacing water towers or elevated tanks. The system involves the use of two air-tight tanks, a pump and an air compressor. One tank is kept constantly charged with air at a high pressure, while the other contains both air and water, the air being admitted to the second tank from the first by a pressure-reducing valve set to give constant pressure in the second tank and the water being forced into the tank by a

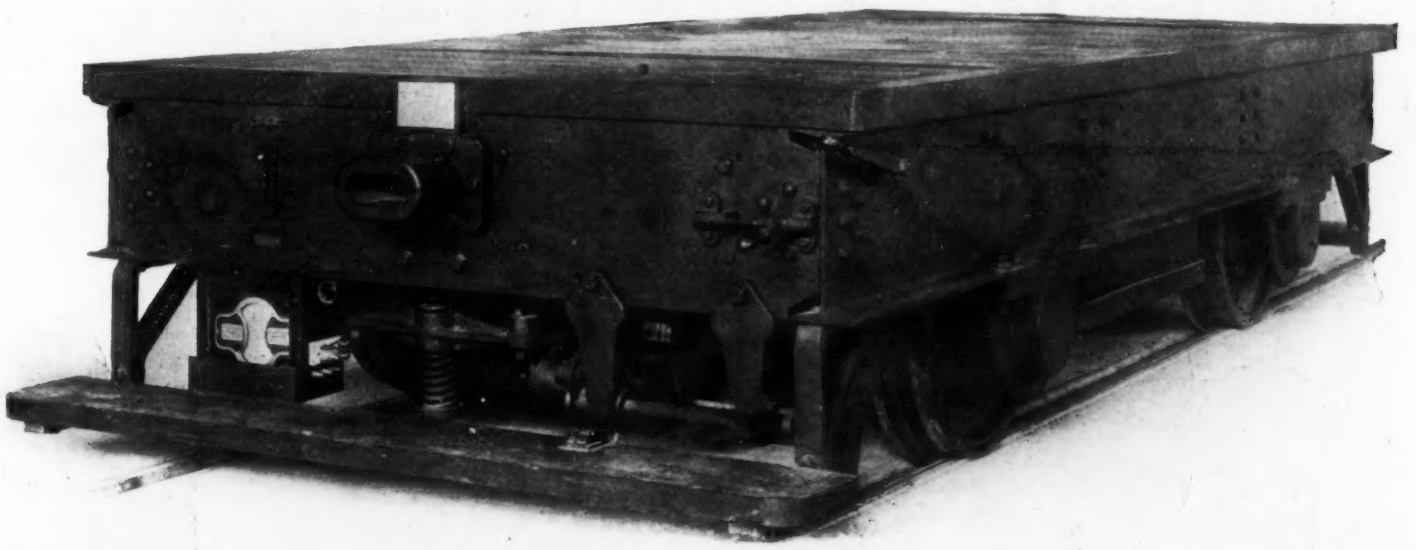
pump. The entire contents of the water tank may be used under a constant pressure without operating either the compressor or pump, and it is necessary to run the latter only at such times as are found convenient for charging the system. As the water is pumped into the water tank the air is removed by the compressor and returned to the air tank, so that the water pump always operates against a uniform pressure.

The apparatus exhibited includes two tanks, each 5 ft. in diameter and 10 ft. long, and an air compressor and a pump operated by a single 5-hp gas engine. The pump is of the Deane vertical, triple-geared type, and is fitted with 4-in. cylinders, the plungers in which have a stroke of 6 in. These pumps are designed for a pressure of 100 pounds per square inch and a speed of 47.3 r.p.m., the speed of the gas engine being 280 revolutions.

A Storage Battery Railway Auto-Truck.

An interesting application of the storage battery to transportation may be seen in the Westinghouse exhibit, St. Louis. A standard-gauge truck is equipped with a storage battery and motors and designed for carrying materials or to be used as a locomotive. It is intended for hauling heavy materials in large industrial establishments, and is especially adapted to supplement electric crane service, replacing more primitive methods of transportation. It assures a safe, prompt and cheap handling of heavy pieces between different parts of the works. The Westinghouse Machine Company, as a necessity in its own plant, has developed the truck and a large number are operated about the works at East Pittsburg.

In its general construction the truck resembles an ordinary slow-speed electric delivery wagon, except that it is adapted for running on a railroad track. The truck with complete equipment weighs 9,500 pounds and has a carrying capacity of 100,000 pounds. When used as a locomotive, its drawbar pull is 1,000 pounds, with a speed of from ½ to 2½ miles per hour.



STORAGE BATTERY AUTO-TRUCK.

It has a substantial steel frame carried on four iron wheels. Each axle is driven by a Westinghouse motor. The storage battery cells have been specially designed for this service, which requires heavy outputs for short periods. The deck, 6 ft. 9 in. by 12 ft. 10 in., is constructed of heavy matched wood, easily removable to permit of access to the batteries. The wheel base is 8 ft. 11 in., the heighth over all 2 ft. 7 in., the width 7 ft. 4 in., and the length 14 ft. 4 in. The truck is operated from one end by two hand levers; one reversing the direction of running and the other giving four different speeds in either direction. The operator has always under foot the lever of a mechanical brake and the push button of a signal bell. The truck is provided at both ends with drawbar heads and with receptacles for charging the storage battery; it also has a voltameter for indicating the current which is drawn from the battery at any moment, as well as the voltage of the battery which indicates its condition.

This truck when used either as a transfer truck or as a locomotive can be operated by any ordinary laborer. It can be left standing and may be moved only by those having authority to do so, as the handle of the main switch is made removable and can be carried about by the attendant. It requires no trolley wire, which would interfere with the handling of materials by cranes, and there is no fire risk.

Allis-Chalmers Prizes at St. Louis.

Advices from St. Louis indicate that the Allis-Chalmers Company, of Milwaukee, has cleaned up the field of awards very thoroughly; in fact, if there is anything it has not got away with, the omission must be due to sheer oversight. A telegram from Mr. Arthur Warren, head of the company's department of publicity, says: "We have swept the field and won the highest awards at the Exposition, including the grand prize in every department of steam engines, electricity and mining machinery; also a gold medal for the Bullock system of operating variable-speed electric motors. One grand prize is for the Allis-Chalmers "Big Reliable" engine, the largest ever seen on exhibition. Another grand prize was for one Bullock electric generator, these two machines comprising the huge unit which supplies the world-famous decorative lighting at the Fair, and much of the power. Another grand prize was for our exhibit in the Department of Mines and Metallurgy. There is nothing worth while left to be won. We have taken everything in sight."

Institute Meeting.

The 190th meeting of the A. I. E. E. will be held at 8.15 p.m., tober 28, at the Chemists' Club, 108 West Fifty-fifth Street, New York. The following papers will be presented for discussion: "The Telautograph," by Thomas Dixon, associate, electrical engineer with the Gray National Telautograph Company, New York. "The Transposition of Electrical Conductors," by F. F. Fowle, associate, with the railroad department of the American Telephone & Telegraph Company, New York.

Meeting of the Western Society of Engineers.

The first meeting of the season of the electrical section of the Western Society of Engineers was held Friday evening, October 14, in the society's rooms in the Monadnock Block, Chicago. At a short business meeting rules were adopted for the government of the electrical section. Mr. F. M. Davis, of the engineering department of the Kellogg Switchboard & Supply Company then read a paper entitled "Some Notes on the Edison Nickel-Iron Storage Battery." A short description of the battery was given, after which curves of tests made upon the battery were shown by means of a lantern, and explained.

The paper was freely discussed by those present, and many interesting points were brought out as to the advantages and disadvantages of the Edison cell and the lead cell for different services.

The Western Electric Company's Exhibit, St. Louis.

One of the most complete exhibits of electrical apparatus at the Exposition is that of the Western Electric Company in the Electricity Building. For the visitor's convenience the space has been divided by aisles into five parts, in each one of which is arranged apparatus, pertaining to some particular branch of electric lighting or power. Walking from the main aisle to the central enclosure the visitor comes to a large motor-generator, shown in Fig. 1. The motor part of this set takes current from the 500-volt power circuit of the Exposition company and the generator delivers current of 220 volts at the distributing switchboard located nearby. This motor-generator operates in conjunction with a compensator so that current of 110 and 220 volts is available for distribution, with the result that from this unit power motors, fan motors, arc and incandescent lamps of 110 and 220 volts are operated in different parts of the space.

By reference to diagrams 1, 2 and 3, the arrangement of the compensator system may be noted. A compensator set usually consists of two 125-volt or 250-volt compound-wound machines, connected in series across the main wires which have a potential of 250 volts or 500 volts. In diagram No. 1 the load is supposed to be equal on both sides of the neutral wire, in which case both machines are running as motors, the current passing in the direction indicated in dotted line. Under these conditions the compensator is not affecting the circuit.

In diagram No. 2 the excess of load is shown between the positive and neutral wire, in which case the unit of the compensator connected upon this side of the neutral is driven as a generator by its twin, generating an amount of current necessary to restore the voltage balance, the currents then flowing in the direction indicated by the two dotted lines. In diagram No. 3 the conditions are reversed, the machines between the neutral and negative wire operating as a generator, its twin driving it as a motor. It will be seen from these diagrams that either machine will operate as a motor or generator according to the distribution of the load and will equalize the load under all conditions of unbalance up to the full capacity of the compensator. Diagrams 1, 2 and 3 show only the connections of the motor as regards the distribution of the load.

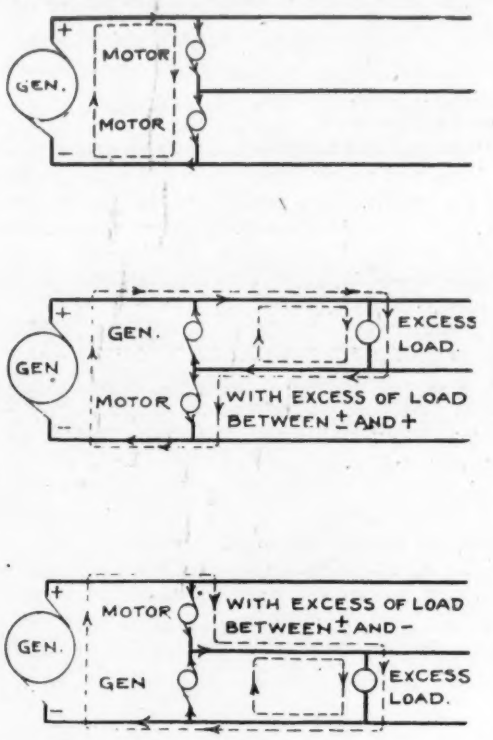


FIG. 2.—DIAGRAMS 1, 2 AND 3, SHOWING CONNECTIONS OF COMPENSATOR.

Diagram 4 shows the actual application of this system as used in the Western Electric Company's exhibit.

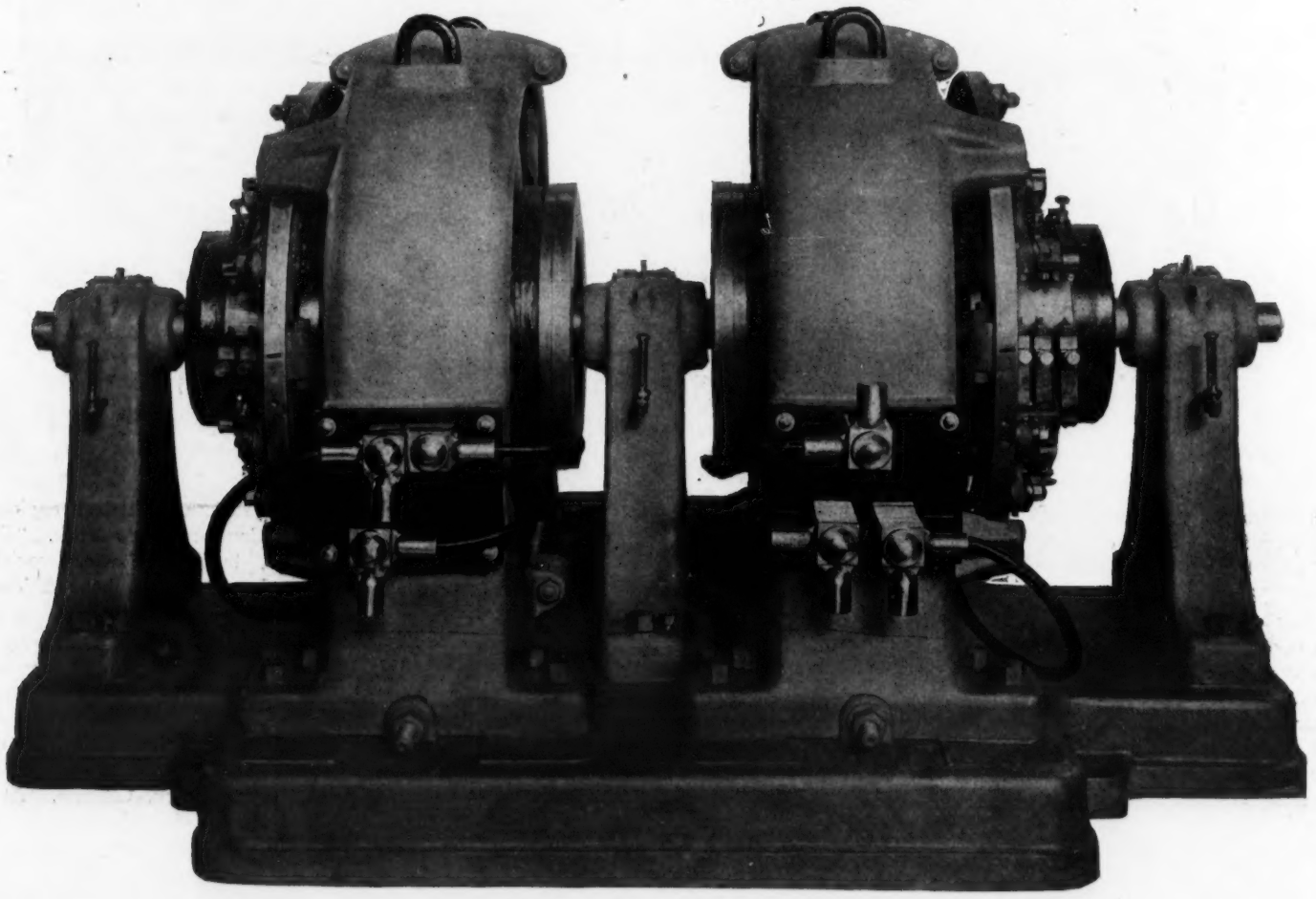


FIG. 1.—MOTOR-GENERATOR.

Such a compensator system is desirable where power and lighting circuits are to be operated from a single generating unit, and in selecting the size of compensator sets several points are to be considered. The total capacity of the load carried directly across the

outside wire does not in any way affect the size of the compensator —that is, motors of continuous operation at constant speed and connected directly across the outside wires do not affect calculations as to compensator capacity. It is safe to install a compensator having a capacity of 10 per cent. of that portion of the load subject to

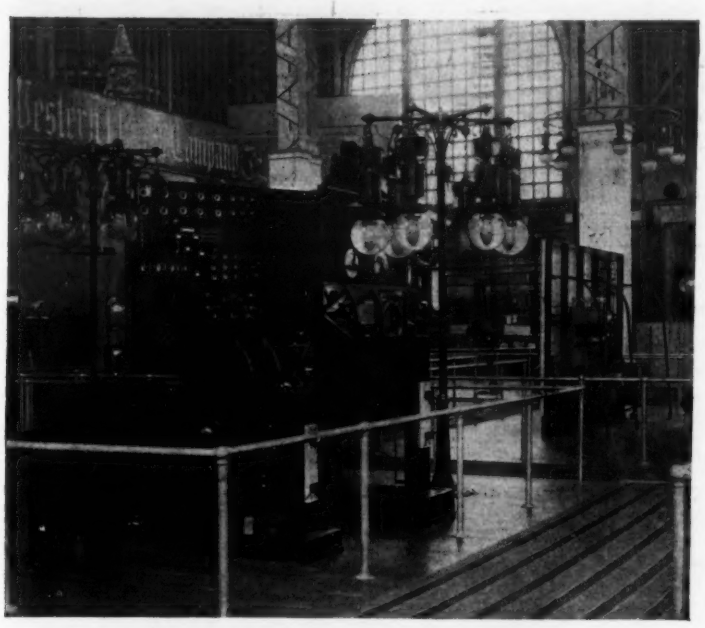


FIG. 3.—ARC LIGHTING SYSTEM.

unbalance—that is, 10 per cent. of the load which is connected on both sides of the neutral.

In a plant whose total load reaches 300 kw, of which 150 kw are consumed in motors or other apparatus connected directly across the outside wires, and the other 150 kw are consumed in lamps or motors connected between the neutral and either of the outside wires, and therefore subject to unbalance, a compensator of 15 kw or 10 per cent. of the load subject to unbalance would ordinarily be sufficient. Some of the advantages derived from an installation of this character are shown in a striking manner in one part of the exhibit, given up to motor-driven machine tools. Here, aside from furnishing the light, current of 110 and 220 volts from the motor-generator is used to operate a series of variable-speed motors, direct-connected to machine tools of different kinds. The Western Electric Company's system of variable-speed motors shown is a somewhat recent and very important development. Where these variable-speed motors are installed for machine tool work, a three-wire, equal voltage system, such as the one in use, is recommended, the potential of the outside wires being from 220 to 250 volts and that between the neutral and outside wires being from 110 to 125 volts. The arrangement of the wiring for such a system is given in diagram 4. Among the many points of advantage claimed the following are the most prominent: A perfect system of distribution for incandescent and arc lights. A motor speed range of from 4 to 1 or 6 to 1. Minimum first cost owing to the simplicity of wiring.

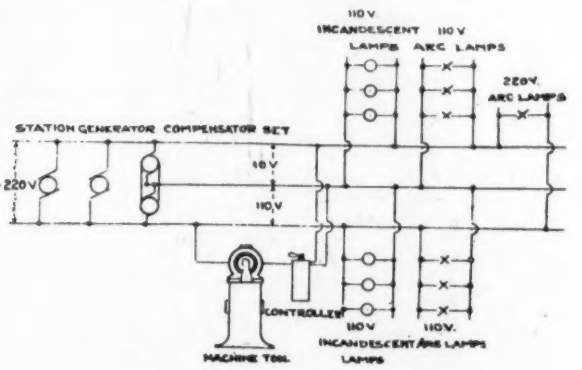


FIG. 5.—WIRING DIAGRAM.

The following tables of data relate to the individual machine tools seen in operation in this exhibit:

A 24-in. back-geared shaper made by the Cincinnati Shaper Company is equipped with a 2-hp variable-speed motor running from

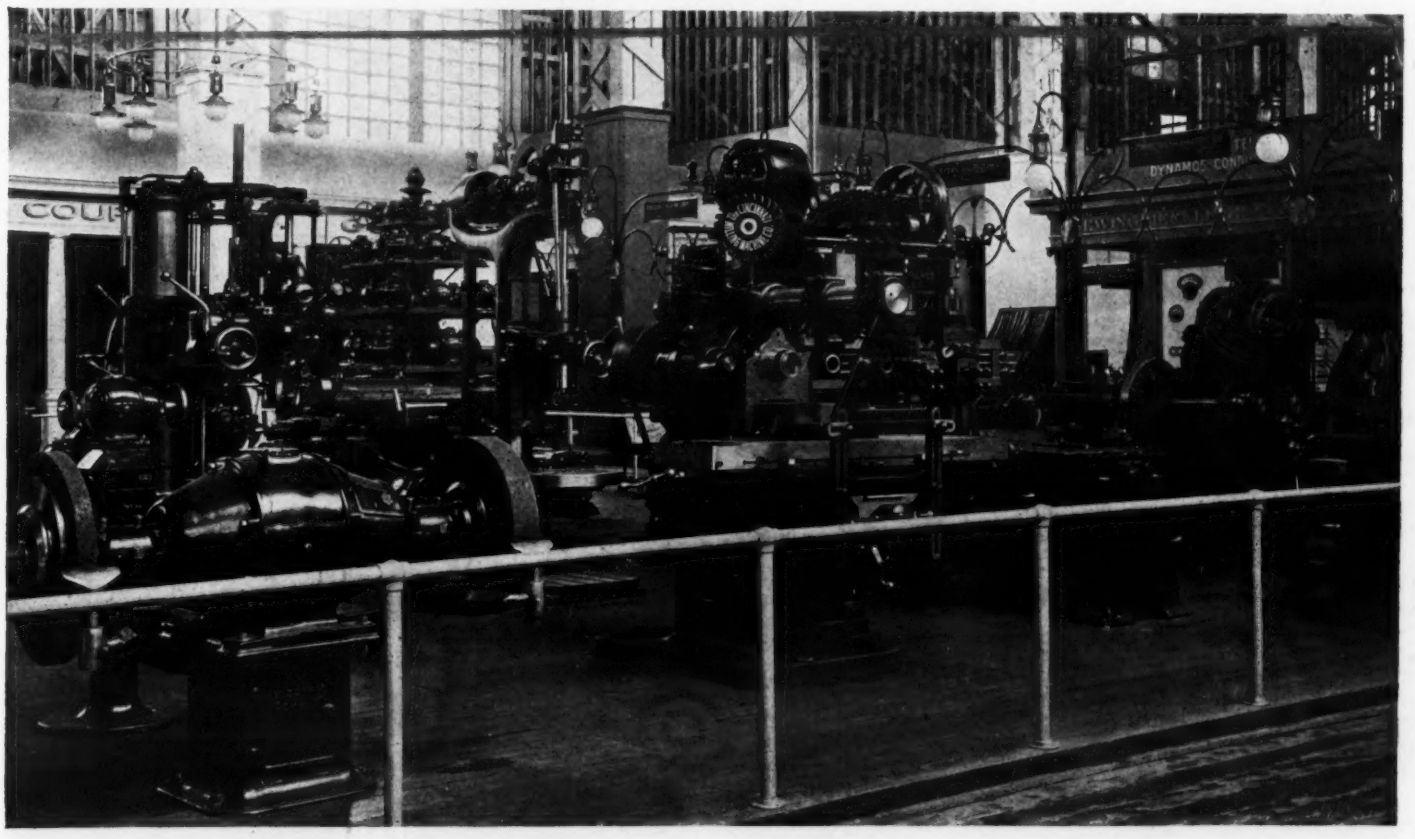


FIG. 4.—GENERAL VIEW OF EXHIBIT OF MACHINE TOOLS.

the three-wire system at a speed of 300 to 1,200 r.p.m. on 110 and 220 volts. The power transmission to the tool is by silent chain and the machine is provided with a clutch which may be used in starting and stopping.

A 24-in. engine lathe made by the Lodge & Shipley Machine Tool Company is driven by a 7½-hp variable-speed reversible shunt motor, semi-encased, operating on 110 and 220 volts, three-wire

system, with a speed of 290 to 1,280 r.p.m. A geared motor is above the head stock. The regulation is by means of a Western Electric TW-4 drum type controller, connected by means of sprocket chain, to a splined shaft, which is operated by a lever on the lathe carriage.

The Cincinnati Milling Machine Company shows a No. 4 plain miller driven by a 5-hp variable-speed, 220-volt shunt motor, en-

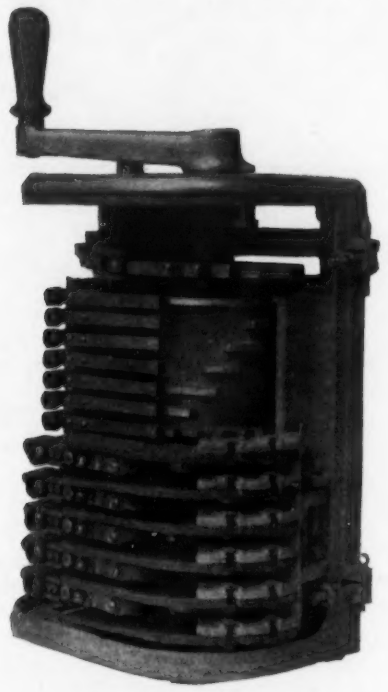


FIG. 6.—SPECIAL CONTROLLER.

cased type, with lower covers perforated. The speed variation from 620 to 1,550 r.p.m. is accomplished by field control.

A 32-in. upright drill of the Cincinnati Machine Tool Company's make is operated by a 2-hp, 220-volt, semi-encased shunt motor at 1,000 r.p.m. The motor is direct-geared to the lower cone shaft of the drill and is regulated from a Ward Leonard SKN panel with starter, switch and fuses. Speed variations are by means of standard cones and belt on the machine.

Cincinnati Planer Company is represented by a 30-in. x 30-in. x 8-in. planer driven by a 7½-hp, ¼ compound, 220-volt, semi-encased motor, operating at 875 r.p.m. The motor is on top of the hous-

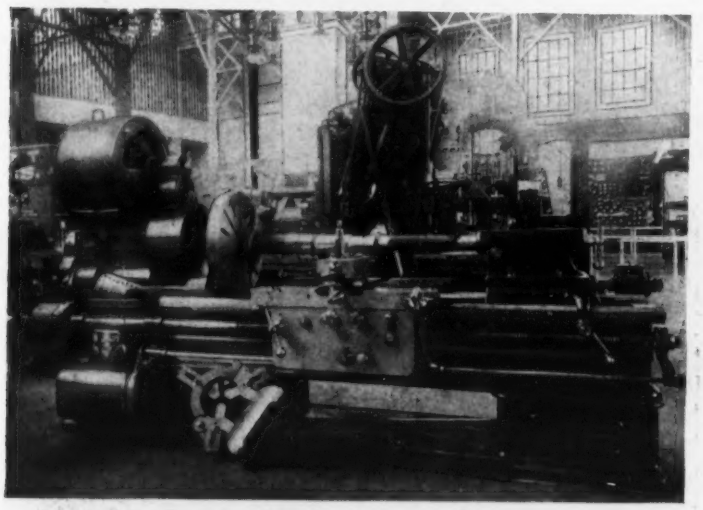


FIG. 7.—ELECTRICALLY-DRIVEN LATHE.

ings, direct-connected to the gear box, which operates the machine by means of "open and crossed belts" in the usual manner. J. L. Schureman & Co. supplied a type "A" self-starter with push button switch; speed variation on the cutting stroke is obtained by gear changes in the gear box on the machine, which insures a constant speed on return stroke.

A Gould & Eberhardt 48-in. x 12-in. automatic gear cutter is driven by a 3½-hp, 220-volt, shunt-wound, semi-encased motor operating at 1,000 r.p.m. Silent chain is used in driving and speed changes are obtained by changes of gears.

For machine tools requiring a great speed variation, the Western Electric Company has designed a special controller, shown in Fig. 6, and in active operation on the shaper and engine lathe in its exhibit. To those versed in the operation of machine tools an inspection of these controllers will prove of great interest. For aside from containing modern improvements a special reversing attachment is included within the device, enabling the attendant to secure the same number of speeds in the reverse as are obtained in the forward direction.

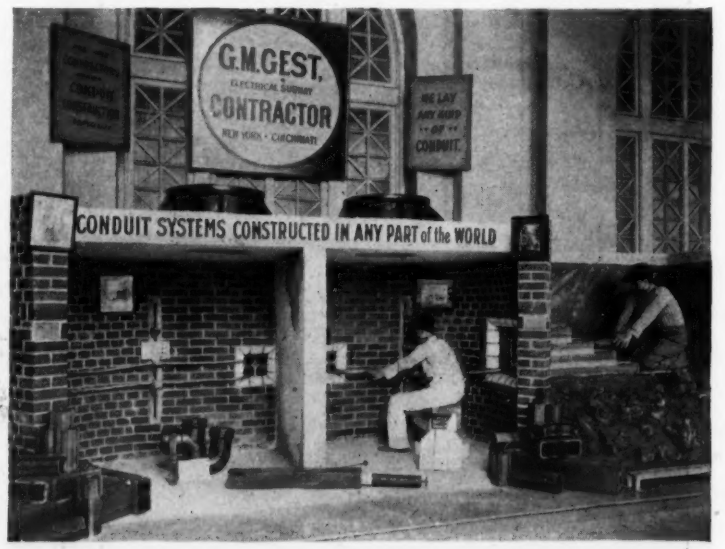
In designing this controller the fact was taken into consideration that all machinists who operate lathes are not electricians; hence, every safeguard has been used to prevent accidents or damage to the electrical apparatus through carelessness or unfamiliarity.

The controller at the head of the lathe shown in Fig. 7 is operated by means of a lever arranged upon the lathe carriage or apron, so that it is always within reach of the attendant. As a further precaution a telltale lamp is mounted so as to be always within the direct range of the attendant's vision, and gives warning when the controller is not left on a regular running notch. Also there is an absolute stop of the handle at "off" position, so that the controller cannot reverse the motor if handled by a careless operator.

The "live" parts are completely assembled within the controller case, all readily accessible and similar parts interchangeable. With these controllers 15 different speeds, in each direction between the maximum and minimum, may be secured. Fig. 4 gives a general photographic view of the section occupied by machine tools equipped with variable-speed motors.

A Conduit Exhibit at St. Louis.

One of the most original and attractive exhibits in Electricity Building at St. Louis is that made by Mr. G. M. Gest, the well-known subway contractor, of New York and Cincinnati. The exhibit, which is here illustrated, consists of a manhole divided by a concrete wall, virtually making two holes out of one. The front section is open, showing the company's patent enamel terminal brick used around the ducts entering manholes for the protection of cables; patent frame and adjustable cable brackets (single, double and triple); patent sewer trap, burlap machine, mandrels



CONDUIT EXHIBIT.

and other devices used in the construction of underground conduit work.

A conspicuous feature of the Gest exhibit consists of two life-size wax figures of workmen, one demonstrating how tile should be laid in the trench, and the other showing how cables are spliced. The work is, therefore, accurate and true in every respect except that of being "still life," but even this has its advantages, as can be inferred from the engraving herewith presented of the exhibit.

Electricity at the Commercial Traveler's Exposition in Boston.

A number of interesting electrical exhibits are shown this month at the exposition of the United Commercial Travelers in Boston, which is being held at the Mechanics Building, on Huntington Avenue. Power and light for the exposition are supplied from the regular isolated plant of the building, distribution being at 110 volts. Both incandescent and enclosed arc lamps are being freely used to illuminate the exhibition halls and to decorate the numerous booths in which manufactured articles are displayed; to light kinetoscopes, show cases and a small photographic establishment. Although the wiring of the booths was a temporary piece of work on the rush order, it bears evidence of having been installed with due regard to the fire risk.

Near the entrance of and inside the building is a post-office, Western Union telegraph and cable office, and a telephone public pay station of the New England Telephone & Telegraph Company. A private branch exchange connects the different departments of the building with the city exchanges outside, and through them long-distance connections may be had to all points reached by the Bell system in the East and Middle West. Scattered through the building are a number of watchmen's clock stations connected with the exhibit of the Simplex Time Recorder Company, of Gardner, Mass. These stations each contain a magneto operated by a watchman's key and the record of the visiting time at each station during the night is obtained daily from a recording clock mechanism at the exhibit and freely shown to visitors. In its improved form the system consists of a recorder placed at a central point, such as a factory office, with a rectangular straight-ruled sheet marked in the minute divisions, and driven by clockwork. The sheet is mounted on a grooved drum of hard rubber, the old form of round dial having been discarded. Each station actuates a group of magnets which move a lever that punctures a hole in the record sheet by means of a prick point. Whenever the door of the recorder is opened or closed a punch mark is registered on the record sheet, so that no tampering is possible. The exhibit also contains various styles of time-recording clocks for use in factories, offices and stores where it is desired to keep an accurate record of employes' time. These clocks operate entirely on mechanical principles, however, and are less interesting from an electrical standpoint than the watchmen's clocks. A noteworthy feature of the employes' time recorder is the interlocking mechanism, which prevents two employes from registering at the same instant.

The Boston & Worcester Street Railway Company has advertised its air line route extensively at the exposition by means of neat circulars attached to walls and building columns. For 80 cents it is possible to go and return from any point on the Boston Elevated system to any point on the Worcester Consolidated lines, covering a trip of from 80 to about 110 miles, and the attractions of the route are being pointedly presented to visitors at the exposition.

An interesting electrical exhibit is that of the Boston Sign Company, which has exposed a large number of automatically operated and illuminated advertising signs in its booth. Various colors of light and different styles of lettering enable the visitor to see just what effect the different signs give when flashed or fixed, and the flashing machinery is shown in full operation "with the lid off," and driven by a small 110-volt motor.

Of interest to operators of automobiles, motors, small and large engines, agricultural machinery, street cars, etc., is the exhibit of the Hughes Anti-Friction Company, of Charlestown, Mass. Samples of a special lubricating grease are being distributed to interested visitors, who are thus enabled to test for themselves the claims of the manufacturers. Among the special features claimed for this improved lubricant are: Freedom from acid, alkali and animal fats; non-dripping, prevention of corrosion, non-caking or influence by water, long life and reduction of friction by 50 per cent. T. H. Childs & Co., confectioners, have a motor-driven candy-puller on exhibition and V. J. Emery, of Wollaston, is showing some beautifully compact four-cycle marine type of gas engines in sizes of 4, 8 and 16 hp. Hunt & Prescott, of Boston, managers of the Park Square Garage, have an extensive exhibition of touring cars and automobile runabouts in the basement of the building.

Among the prominent motor-driven exhibits is that of the United Shoe Machinery Company, of Boston. A ½-hp, 110-volt, 1,500-r.p.m. motor made by the Fidelity Electric Company, of Lancaster, Pa., drives a line shaft operating a double eyelet and a "Wunderhook" machine, each of which is used in stamping eyelets and hooks into shoe leather. Holden, Rigby & Sons, of Paterson, N. J., also have on exhibition a large weaving machine operated by a 1-hp motor. This machine turns out fancy handkerchiefs and scarfs, with a pattern appropriate to the Louisiana Purchase Exposition interwoven into the texture of the cloth. The Foster Rubber Company, of Boston, makers of rubber heels and soles, are exhibiting a machine which crimps rubber cloth before it is molded into heels and soles. This machine is run by a belted 3-hp Sprague motor. Peter Forg, of Somerville, Mass., has an interesting exhibit of new styles of electric light adjustable fixtures for use in factories, offices, designing and reading rooms. Various arrangements of ball and socket joints, sliding and telescoping rods and adjustable screw handles are used to enable incandescent lamps to be turned in every conceivable position.

The Gray National Telautograph Company has a working exhibit in the main hall and visitors are freely permitted to write messages to one another and to observe their successful transmission and reception, the original and the received messages being given away whenever requested. The working parts of the apparatus are exposed to general view, and a pamphlet sheet setting forth the well-known advantages of the apparatus is being distributed. Besides the increasing use of the telautograph in banks and other mercantile establishments, a special point is made of its adaptability to railway train order transmission. A novel use of the apparatus is between the stage manager and the orchestra leader of Keith's Theatre in Boston, who are thus enabled to communicate without the slightest trouble amid the uproar of a rollicking vaudeville chorus—an act practically impossible by telephone, voice or speaking tube. The exhibit is under the general direction of Henry Keep, New England representative.

The Earnshaw Manufacturing Company and the Service Water Tube Boiler Company, of Boston, have an interesting working exhibit of their recently designed apparatus. The former company makes a steam generator which consists of a set of water tubes that can be applied to any horizontal return tubular boiler for the purpose of increasing its economy from 10 to 25 per cent., and its capacity from 25 to 50 per cent. These tubes are placed below the regular water drum in the furnace space and connect with a steam pipe, which discharges in the regular steam drum above the water line. Rapid circulation, quick steaming power and absence of foaming and scaling are thus obtained without change in feeding, firing or running the original boiler. The latter company, which is affiliated with the former, exhibits also a working model of a boiler with an adjustable fire wall and improved heating surfaces for residential and apartment house purposes.

Although the use of electricity in the exposition is rather scattered, it is in evidence at almost every turn. Even in the exhibit of the Boston Association for the Relief and Prevention of Tuberculosis an electric heating pad is shown in a consumptive's outfit, the pad being made by the Simplex Electric Company, of Cambridgeport, Mass. One might wish that the cooking apparatus and sewing machines in some of the exhibits were electrically operated instead of run by gas and foot power, but in the main the Commercial Travelers' Exposition well illustrates the fact that electricity cannot be dispensed with in these times, go where one will. From the guide in the woods, who telephones many miles ahead to have supper ready for his party at the end of the last long "carry," to the manufacturer, who wishes to show his machinery to the visitors at the exposition, electricity proves to be the most useful and faithful of servants.

Washoe Power Company, Nevada.

Bids have been opened for a 750-kw, three-phase generator and other equipment of the Washoe Power & Development Co.'s electric transmission plant, which is to be installed eight miles from Reno, Nev., and will supply light and power for that city and vicinity. It is reported that the Stanley Electric Manufacturing Company secured the order at a very reasonable figure, underbidding a number of competitors. Meredith, Allen & Cory are the consulting engineers. Raising and lowering transformers for a line voltage of about 20,000 volts, together with switchboards, exciters, etc., are to be included in the contract. Current will be generated at 2,300 volts, a Pelton water wheel being used.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was quiet and easy, being quoted at 1¾ to 2 per cent. on call, and 3½ per cent. for 60 days. The stock market was active and strong and there was evidence of increased outside participation, in many cases the highest prices of the year being reached. Reactions, due mainly to profit-taking, were followed by renewed advances, the railroad list with few exceptions showing decided strength, while industrials were a feature with considerable activity at higher figures. United States Steel issues advanced and were strong, common rising to 20¼ and preferred to 79⅞. Brooklyn Rapid Transit was the feature of the traction group, showing great activity and advancing from 58½ to 68½ on what was alleged to be manipulation by a leading operator. There was also continued support of Amalgamated Copper, which had a further improvement on the favorable developments in the copper trade. At the close of the week the market was extremely active. On Friday the transactions were over 1,500,000 shares, making it the largest day's business of the year. Brooklyn Rapid Transit closed at 67⅜, this being a net gain of 8½ points. Metropolitan Street Railway closed with a net gain of 1⅞, the closing price being 122⅜. General Electric fluctuated between 170¾ and 176, closing at 175—an advance of 3 points. Allis-Chalmers, common, gained ⅝ point, and preferred lost 2 points, closing at 12½ and 50, respectively. The Westinghouse issues made substantial gains, common 3½ and preferred 4½, the closing quotations being 169 and 192, respectively. Western Union is up ½, closing at 92½, and American Telephone & Telegraph ½, closing at 140. Interborough Rapid Transit closed at 148, a net gain of 1 point. Curb stocks scored general advances with gains of 1 to 4 points in some shares, Mackay common being one of the two stocks showing the extreme improvement. The cause assigned for the activity of this stock was the likelihood of a 2 per cent. dividend. The closing quotation of the common was 35 and of preferred 74½. Following are the closing quotations of October 18:

NEW YORK

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
Allis-Chalmers Co.	10	10⅛	Electric Vehicle	14	15
Allis-Chalmers Co. pfd.	42	50¼	Electric Vehicle pfd.	20	22
American Tel. & Cable.	92	92	General Electric	171	177⅛
American Tel. & Tel.	138½	143	Hudson River Tel.	...	...
American Dist. Tel	24	26	Interborough Rap. Tran.	146	148½
Brooklyn Rapid Transit.	60¾	67⅛	Metropolitan St. Ry.	120⅝	122⅛
Commercial Cable.	200	210	N. Y. & N. J Tel.	156	157
Electric Boat	37	38	Marconi Tel.	...	...
Electric Boat pfd.	69	70	Western Union Tel.	91¼	92⅛
Electric Lead Reduction	¼	¼	Westinghouse com	165	170¾
			Westinghouse pfd	190	193

BOSTON

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
American Tel. & Tel.	139	143⅜	Western Tel. & Tel. pfd.	93	95
Cumberland Telephone	116½	117	Mexican Telephone	1¼	1⅝
Edison Elec. Illum	*254¾	250	New England Telephone	130½	132
General Electric	171	177⅛	Mass. Elec. Ry	13⅛	*14
Western Tel. & Tel.	13	18	Mass. Elec Ry. pfd.	55	54½

PHILADELPHIA.

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
American Railways	47⅛	47¾	Phila. Traction	97⅛	97⅝
Elec. Storage Battery	68⅛	73	Phila. Electric	6⅞	7⅛
Elec. Storage Battery pfd.	68⅛	73	Phila. Rapid Trans.	15	15
Elec. Co. of America	9¼	9⅝			

CHICAGO

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
Central Union Tel.	...	...	National Carbon pfd.	108½	109¾
Chicago Edison	155	158	Metropolitan Elev. com.	23⅛	23½
Chicago City Ry.	170	170	Union Traction	7	7⅛
Chicago Tel. Co.	125	128½	Union Traction pfd.	35	36
National Carbon	32	37			

* Asked

WYOMING VALLEY LIGHTING INTERESTS.—Capitalists owning control in the Gas Company, of Luzerne County, Pa., which supplies gas to Wilkesbarre, and in the Wyoming Valley Electric Light, Heat & Power Company, which supplies electric light and power in the same territory, have sold their entire holdings in both companies to a syndicate of capitalists composed of Forest & Co., bankers, and Charles R. Miller, of Philadelphia, and J. G. White Co. The price paid is $50 per share for the gas stock and $20 per share for the electric light stock, with the agreement on the part of the purchasers to take all stock of both companies that is tendered them by the pool or majority holders, within a limited time, at the same prices. The Ashley Electric Light Company, which recently secured a franchise to enter Wilkesbarre, is also included in the deal. The purchase is being made in the name of the Susquehanna Light Company, a Delaware corporation, but it is understood that all the stock will be turned over to a new corporation to be called the Wilkesbarre Gas & Electric Company, a consolidation of all three companies under the Pennsylvania law. This company will have a capital stock of $1,500,000, and an authorized bond issue of $3,000,000, of which $1,000,000 will be deposited with the trustee of the mortgage to provide for retiring at maturity the present outstanding bonds of all the companies; $1,000,000 will be now used to pay for the stock of the constituent companies, and provide about $325,000 for immediate additions and improvements and the balance reserved for future acquisitions. Large additions will be made to the electric light plant. The present electric sub-station on Washington Street will be abandoned and the gas and electric business of Wilkesbarre and the immediate surrounding territory pushed and developed. New officers will be elected for the consolidated property.

DIVIDENDS.—Michigan State Telephone directors have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable November 1. The International Power Company has declared a dividend of $3 per share on the preferred stock, payable December 1, 1904. This is in addition to the dividend of $3 per share on the preferred stock, which is payable on October 15, 1904. The United Electric Securities Company has declared a regular semi-annual dividend on preferred stock of $3.50, payable November 1. The directors of the Milwaukee Electric Railway & Light Company have declared the regular preferred quarterly dividend of 1½ per cent., payable November 1. The Columbus Street Railway Company has declared a dividend of 1¼ per cent. on the preferred stock, payable November 1. The directors of the Henry R. Worthington Company have declared the regular semi-annual dividend of 3½ per cent. on the preferred stock, payable November 1. The Chicago Edison Company has declared the usual quarterly dividend of 2 per cent., payable November 1. The Automatic Electric Company has declared a 2 per cent. dividend for the last quarter, payable November 1.

ELECTRICAL SECURITIES CORPORATION.—The Electrical Securities Corporation was incorporated at Albany on October 13 in the office of the Secretary of State, with a capital of $3,000,000. The principal office is in Schenectady, and the purpose of the corporation is to manufacture and deal in electrical, gas, water and steam power machinery. The stock is divided into $1,000,000 preferred and $2,000,000 common. The directors are W. C. Lane, Pliny Fisk, Wilbur C. Fisk, F. L. Eldridge, Oscar L. Gubelman, G. M. Cumming, W. M. Barnum, C. A. Coffin, William C. Cox, Adolphus Smedberg, Jr., Paul S. O'Connor, Robert Maclay, William T. Kaufman and F. W. Walz, of New York; E. T. Stotesbury, of Philadelphia; Gordon Abbott and James J. Storrow, of Boston; M. B. Johnson, of Cleveland; M. J. Perry, of Providence, R. I.; Edward C. Palmer, of Morristown, N. J.; Harry S. Peacock, Jr., of Flushing, L. I.; S. M. Hamill, H. W. Darling and E. R. Coffin, of Schenectady, N. Y.

SALE OF PHILADELPHIA CONDUITS.—The Philadelphia Electric Company has agreed to purchase from the Keystone Telephone Company the latter's conduits and franchises, said to be the most valuable of their kind ever granted by the city, for $2,500,000 cash. In turn, the Keystone Company agrees to use the conduits and pay therefor an annual rental of $125,000. The deal ends the controversy between the factions represented upon the one hand by John M. Mack and his friends and on the other by the Thomas Dolan-Joseph B. McCall syndicate of financiers. The Philadelphia Electric Company now controls the lighting situation, and this purchase should strengthen its position.

SAVANNAH, GA., ELECTRIC ANNUAL.—The annual report of the Savannah Electric Company for the year ended July 31 shows:

	1904.	1903.	Changes.
Gross	$535,166	$503,230	Inc. $31,936
Expenses and taxes	303,631	297,612	Inc. 6,019
Net	$231,535	$205,618	Inc. $25,917
Charges	124,808	115,500	Inc. 9,308
Surplus	$106,727	$90,118	Inc. $16,609

LONDON UNDERGROUND.—Application has been made to list $16,550,000 notes of 1908 of the Underground Electric Railway Company, of London, on the New York exchange. These are the profit-sharing notes issued by Speyer & Co. early in the year in connection with the Yerkes syndicate in London. The money was found for them over here without difficulty and even without the listing there has been a very fair market for them.

CHICAGO EDISON BONDS.—Chicago Edison has sold at private sale $500,000 first mortgage 5 per cent. gold bonds to Russell, Brewster & Co., National City Bank of New York, and N. W. Halsey & Co. The proceeds are to be used for extensions. The price is not announced, but is believed to be close to par.

STONE & WEBSTER COMPANIES.—The Stone & Webster Corporation reports the following earnings:

	1904.	1903.		
Edison Electric Illuminating Co. of Brockton:				
Aug. gross	$8,165	$7,256	Inc.	$909
Net	2,606	1,581	Inc.	1,024
Sur. over charges	1,743	524	Inc.	1,218
Jacksonville Electric Co.:				
Aug. gross	$23,828	$21,789	Inc.	$2,039
Net	10,131	7,651	Inc.	2,479
Sur. over charges	7,114	4,536	Inc.	2,578
Lowell Electric Light Corporation:				
Aug. gross	$17,279	$16,470	Inc.	$808
Net	6,811	5,766	Inc.	1,014
Sur. over charges	5,654	4,654	Inc.	1,000
Savannah Electric Co.:				
Aug. gross	$49,931	$50,755	Dec.	$824
Net	22,555	23,896	Dec.	1,341
Sur. over charges	11,911	14,092	Dec.	2,181
Houghton County Electric Light Co.:				
Aug. gross	$11,873	$10,990	Inc.	$883
Net	4,128	4,081	Inc.	47
Sur. over charges	1,941	1,893	Inc.	47
The Houghton County Street Railway Co.:				
Aug. gross	$18,810	$20,870	Dec.	$2,060
Net	8,982	10,614	Dec.	1,631
Sur. over charges	5,528	7,685	Dec.	2,156
Minneapolis General Electric Co.:				
Aug. gross	$43,519	$39,144	Inc.	$4,375
Net	18,121	16,396	Inc.	1,725
Sur. over charges	8,609	7,170	Inc.	1,439
Tampa Electric Co.:				
Aug. gross	$30,009	$26,507	Inc.	$3,502
Net	13,056	12,074	Inc.	982
Sur. over charges	11,171	9,930	Inc.	1,240
Terre Haute Electric Co.:				
Aug. gross	$54,426	$46,255	Inc.	$8,170
Net	22,110	19,437	Inc.	2,673
Sur. over charges	12,470	12,772	Dec.	302
Seattle Electric Co.:				
Aug. gross	$192,368	$188,541	Inc.	$3,827
Net	58,432	64,712	Dec.	6,279
Sur. over charges	33,074	42,455	Dec.	9,380

GEORGIA RAILWAY & ELECTRIC.—Spencer Trask & Co., New York, have issued a special circular describing the first consolidated mortgage 5 per cent. bonds of the Georgia Railway & Electric Company, of Atlanta, Ga. This is one of the selected bonds offered by that firm at a price to yield 5 per cent., and has for its security a first mortgage on about 70 of the 140 miles of street railroad of Atlanta, Ga., the new modern power house just completed, on the steam heating plant, one of the electric lighting systems, and, subject to but $225,000 underlying bonds, a second lien upon the balance of the property. The company controls the entire street railroad, electric power, light, gas and steam heating business of Atlanta and Fulton County. For the fiscal year ending March 31, 1903, gross earnings were reported as $1,328,995, and net earnings $583,159. The fiscal year has since been changed to coincide with the calendar year, and following is the result for nine months ending December 31, 1903: Gross earnings, $1,424,286; operating expenses and taxes, $818,426; net earnings, $605,860; interest on underlying bonds, $146,062; leaving a balance of $459,798; interest on first consolidated mortgage 5s, $160,275; balance after all charges, $299,523; depreciation and other deductions, $53,184; dividends on preferred stock, $91,500; surplus for nine months, $154,839. The net earnings for nine months ending December 31, 1903 (after deducting interest upon underlying bonds), amounted to nearly three times the interest on the first consolidated mortgage 5s. For the seven months ending July 31, 1904, net earnings increased 19.85 per cent., compared with the same period of 1902. The earnings of the Atlanta Gas Light Company were not included until November 1, 1903.

SCHENECTADY, N. Y.—The Schenectady Railway Company for the year ending June 30 reports comparatively as follows:

	1904.	1903.		
Gross	$654,945	$525,514	Inc.	$129,431
Net	158,528	168,762	Dec.	10,234
Other income	182,173	123,250	Inc.	58,923
Charges	192,452	119,767	Inc.	72,685
Surplus	148,249	172,246	Dec.	23,987
Cash on hand	39,547	21,383	Inc.	17,264

Commercial Intelligence.

THE WEEK IN TRADE.—As a whole trade maintains a satisfactory volume and in the leading branches of manufacture progress, while somewhat slow, is sure and steady. Contracts are being more readily placed for distant delivery, while the percentage of idle machinery is steadily decreasing. Confidence is strengthened by the satisfactory news from leading iron and steel centres, but the best indication of all is the increased ease of collections, which are stated to be better than for nearly two years past. Jobbing and wholesale trade in fall and winter wearing apparel expands gradually, and the eastern shoe trade is receiving good orders. Car scarcity is noted on the Pacific coast which causes a check on wheat movement eastward. Foreign trade returns are irregular. Cotton shipments show the record; wheat export has practically disappeared; export of flour has shrunk greatly and corn shipments are small. Provision exports show a shrinkage, but cattle, oil, copper, iron and steel and general manufactured exports show gains. Gross railway returns for September point to a gain of 4 per cent. over the corresponding month last year, while for the nine months the indicated decrease is less than 1 per cent. All sections, except the Northwest, contribute to the September increase. Iron and steel are in good demand and stronger in tone. In finished products the feature is the demand for railway supplies and large orders for new cars. Hardware is generally active, and lumber is active in the West but quiet in the East. Copper is somewhat easier on the reported withdrawal of export demand. *Bradstreet's* reports the number of business failures for the week ending October 13 as 196, against 195 the week previous and 203 the corresponding week last year.

BALL ENGINE ORDERS.—Among recent shipments of the Ball Engine Company, of Erie, Pa., are the following: Imperial Tobacco Company, Richmond, Va., one 135-hp engine, direct connected to generator; Collins Hotel Company, Cleveland, Ohio, one 60-hp and one 30-hp, direct connected to generator; Central Paper Company, Muskegon, Mich., one 250-hp variable speed engine; Michigan Central Railroad Shops, Jackson, Mich., one 350-hp tandem compound engine, direct connected to alternator; Franklin Engraving & Electric Company, Chicago, Ill., one 100-hp engine, direct connected to generator; Driskill Hotel, Dallas, Tex., one 75-hp engine, direct connected to generator; Parma Creamery Company, Parma, Idaho, one 50-hp engine, direct connected to generator; Washtenaw Light & Power Company, Geddes, Mich., one 450-hp engine; Franklin Electric Company, Franklin, Ky., one 65-hp engine; Union Trust Company, Baltimore, Md., two 80-hp direct-connected engines; George B. Beck Dry Goods Company, Kansas City, Mo., one 250-hp engine, direct connected to generator; Cooper, Wells & Co., St. Joseph, Mich., one 320-hp engine, direct connected to generator; Erwin Cotton Mills Company, Duke, N. C., one 80-hp engine; Imperial Tobacco Company, Danville, Va., one 135-hp engine; Water & Light Department, City of Evansvile, Ind., one 160-hp engine; E. J. Dupont & Co., Carney's Point, N. J., one 100-hp engine; Josephimus College, Columbus, Ohio, one 100-hp engine, direct connected to generator; W. F. & John Barnes & Co., Rockford, Ill., one 135-hp engine, direct connected to generator; The Franklin Electric Company, Conemaugh, Pa., one 80-hp engine, direct connected; Henderson Light & Power Company, Henderson, N. C., one 125-hp engine; Batterson & Eisele, Edgewater, N. J., one 135-hp engine, direct connected to generator; Detroit Sulphite Fibre Company, Detroit, Mich., one 350-hp engine; Cleveland & Sandusky Brewing Company, Lorain, Ohio, one 60-hp engine, direct connected to generators.

THE WELLMAN-SEAVER-MORGAN COMPANY, of Cleveland, O., has been awarded by the Board of Trustees of the Sanitary District of Chicago, the contract for the turbine water wheel equipment for the new power house of the Chicago Drainage Canal. This is the second largest installation of water power equipment of its kind contracted for in the United States, the largest single water power equipment previously contracted for being the one also built by the Wellman-Seaver-Morgan Company, at Sault Ste. Marie, Mich., for the mammoth power house of the Michigan Lake Superior Power Company, and to consist when finished of 50,000 hp. The Chicago Drainage Canal power station, which is to be located near Joliet, will be the most complete and up-to-date plants in the United States, and a model of its kind in every detail. The equipment will comprise four 6,000 hp units of turbine wheels, which will be direct-connected to electric generators. There are also two exciter units of 600 hp each included in the contract. The contract will require about one year for completion.

THE POWER & MINING MACHINERY COMPANY, of New York City, has recently closed a contract with Mr. James E. Hooper, of Baltimore, for a 25 x 30, two-cylinder engine, and two No. 8 suction producers, the plant to be installed in his new cotton mill at Woodberry, Baltimore. The engine as installed will have three rope pulleys for driving to the floors of the mill, and the shaft will be extended for a flanged coupling, so that another 25 x 30, two-cylinder engine can be installed at a later date, it being Mr. Hooper's intention to double the mill after the first half is in operation. This is the first installation that we know of for cotton mill work. The order was obtained after a very thorough investigation on the part of Mr. Hooper and his engineer, C. C. Hedrick, of the Lowell Machine Company. Mr. Hooper's original plan was to install a steam turbine and electric drive, but after going into the matter very thoroughly he decided to abandon the equipment on account of first cost and materially lower efficiencies. This ought to shake up all of us who believe in the superior economics of electricity.

MUNICIPAL LIGHTING PLANT FOR BURLINGTON, VT.—Plans are being drawn by W. R. B. Willcox for the municipal plant which is to be erected by Bellman & Sanford, of New York City, at a cost of $58,000.

PLANT FOR PORTO CABELLO.—On the steamer *Caracas* of the Red D Line, sailed last Saturday Mr. A. Villaroel, general manager of the Porto Cabello Electric Light & Power Company, with the entire outfit just purchased in this country for the new Porto Cabello lighting plant to be installed this year in that city. The electrical equipment consists of a 120-kw generator, requiring a 230-hp engine, all furnished by the Stanley Electric Company, together with transformers and other electric equipment for the plant furnished by the General Electric Company. The plant will start with four thousand incandescent lights and later will be added to as the demand for services increases. Mr. D. S. Van Wagner, an electrical engineer of many years' experience in Latin America, also sailed on the *Caracas*, having been engaged to erect the new works and install the service. Mr. Van Wagner has been for the past few years electrical engineer for the E. W. Bliss Company in Brooklyn. He has represented various electrical supply houses in the past in South America.

WORCESTER, MASS., CITY HOSPITAL.—Among the many recent installations for heating and ventilating public buildings is that for the Worcester City Hospital at Worcester, Mass. The buildings, seven in number, are located a short distance from the centre of the city at the top of a long hill, and are therefore exposed to severe weather in the winter. The arrangement in the new Ward building is typical of the Sturtevant system. A Sturtevant fan draws the fresh air from the top of the building, a distance of about 45 feet from the ground, through brick flues, and into galvanized iron ducts to the tempering coil, where the chill is taken from the air. It is then drawn through the fan, which runs at a slow speed, typical to public building work, and forced through the heater containing coils of 1-inch steam pipes enclosed in a fireproof steel plate jacket and thence to the plenum chamber, which is divided horizontally into two chambers, one for the hot air and one for the tempered air, the latter passing underneath the heater from the fan. By means of mixing dampers, automatically controlled, the air is mixed to a desired temperature and is forced by the pressure from the fan through the distributing ducts to the different rooms. To assure positive ventilation in the rooms, a Sturtevant electric propeller fan located in the basement draws the air through registers in the floor into galvanized iron ducts and discharges it outside.

ELECTRIC CRANES FOR RUSSIAN ARSENAL.—The Shaw Electric Crane Company, of Muskegon, Mich., has secured another contract for cranes to be installed in the Russian Government arsenal at St. Petersburg, where there are already no less than twenty-six Shaw equipments, varying in capacity from five tons to seventy-five tons. The present order is the first one to be secured since the outbreak of the Russian-Japanese war. It calls for two five-ton cranes. The Shaw people report recent receipt of some large domestic orders. An electric traveling crane of 120 tons' capacity has been ordered for installation in the Southern Railway's new locomotive shops at Princeton, Ind. This crane will have two sixty-ton trolleys, one of which will be equipped with a ten-ton auxiliary hoist. Six motors, aggregating 160 hp, will be required to operate the machinery. A 150-ton electric transfer 70-ft table has also been requisitioned for by the Southern Railway. The table will be driven by two motors of a combined capacity of 80 hp. Two fifteen-ton cranes have been ordered by the Connersville (Ind.) Blower Company and a twenty-five-ton trolley crane will be put in the new shops at Stratford, Ont., of the Grand Trunk Railway of Canada.

1,000-HP PLANT FOR BRAZIL.—Contracts have been let in this market for the initial equipment of a water-power plant to be built in the vicinity of Saõ Paulo, Brazil, for the purpose of supplying power for light and other uses to small towns in that part of the world. The plant in the first instance will have a capacity of 1,000 hp, but eventually it will be capable of developing at least double that quantity. The machinery now on order includes a 1,000-hp water turbine, to be built by the Pelton Water Wheel Company, and a 500-kw generator, which has been contracted for with the General Electric Company. There will also be some 25 General Electric transformers. The Pelton people will also supply the necessary pipe, etc. Mr. Byington, of Saõ Paulo, who is an engineering expert and is primarily interested in the enterprise, has left for Brazil after a short visit here. He placed the contracts and is expected to return to the United States in the near future in order to purchase the additional equipment to be installed.

MORE EQUIPMENT FOR SAO PAULO.—The Saõ Paulo Tramway & Power Company, Limited, of which Mr. F. S. Pearson, 29 Broadway, New York, is the consulting engineeer, will shortly award contracts for equipment which will result in an expenditure of fully $1,000,000. The company at present operates a 10,000-hp plant for the purpose of furnishing power for light and general power use in and around Saõ Paulo, one of the most prosperous cities in Brazil. The existing power plant consists of General Electric generators and Stilwell-Bierce and Smith-Vaile turbines, while recently a turbine contract was given to Escher, Wyss & Co., of Zurich. The equipment about to be ordered will be composed of large rotary converters and transformers. Mr. W. P. Plummer, 29 Broadway, is the purchasing agent for the Saõ Paulo Company.

THE CHICAGO TELEPHONE COMPANY reports a gain of 1,056 telephones for September. The company now has in service in the city and country 113,705 instruments. On October 1 there were 3,000 unfilled orders on hand. The new exchange building of the company on Washington Street will be completed before next May. Work on the structure, which is to cost several hundred thousand dollars, will be commenced before the end of the year. The money for meeting this expenditure was provided by the last sale of stock.

BIG MEXICAN WATER POWER SCHEME.—The construction of a very large water power plant is projected on the Amacusac River, located in the State of Morelos, Mexico, for light and general power use in that vicinity. The plant will be located near the town of Jojutla, and part of the current will be utilized for lighting that place. Mr. Samson Lang, of Mexico City, is primarily interested in the enterprise. The plant, it is anticipated, will be one of the biggest of its description in the southern republic.

LIGHTING SYSTEM FOR AUCKLAND, NEW ZEALAND.—The construction of an electric light and power system is projected in the city of Auckland, New Zealand, at an estimated cost of about $375,000. A power plant is already operating there, but the energy is consumed entirely by the electric traction system which was recently completed by J. G. White & Co., Limited, of London, and which is largely controlled by the British Electric Traction Company, Limited, of London, England.

POWER FOR PINOS ALTOS MINES.—Mexican advices state that the Pinos Altos Mines Company, which is composed principally of Pittsburg capitalists, has decided to construct a water-power plant for the purpose of generating current to operate its mines at Pinos Altos. Power will be transmitted from a point situated about 15 miles from Pinos Altos. About 2,500 hp is available. Mr. E. M. Ray is general manager of the company.

SEWAGE PLANT FOR COLUMBUS, O.—The Board of Public Service of Columbus, O., has awarded a contract to Woolen & Callen, of Indianapolis, for the equipment of a pumping station for the new sewage disposal plant in that city, including two direct current generators connected to vertical engine. The city furnishes the building and foundations and the plant is to be completed by May 1, 1905.

ELECTRIC TRACTION FOR MAZATLAN.—The Occidental Construction Company, of Mazatlan, Pacific Coast of Mexico, contemplates the construction of an electric traction system in that part of the world. The same American concern proposes to construct a road between Mazatlan and Culiacan, the capital of the State of Sinaloa. Mr. Lewis Warfield is general manager of the Occidental Company.

EQUIPMENT FOR MEXICAN MINES.—The American-Mexico Mining & Developing Company, whose headquarters are in Chicago, Ill., is about to let contracts for considerable electrical equipment to be installed on its Mexican properties located in the State of Durango. The machinery to be ordered will include several electric mining hoists and about one hundred electrically operated drills.

LIGHTING SYSTEM FOR CULIACAN.—Mexican advices state that three bids have been received by the municipal authorities of Culiacan for the construction of an electric lighting system in that Sinaloa city. The Braniffs, who represent the Westinghouse interests in the southern republic, are after the contract. So are Carlos Escobar and Nicholas Tortolero Vallejo, both of Mexico City.

SAMSON TURBINES FOR MEXICO.—James Leffel & Co., of Springfield, Ohio—New York offices, Beard Building, 120 Liberty Street—manufacturers of the Samson turbine, recently secured fair-sized contracts through their Mexican representative, Mr. W. G. Moler, of Mexico City, from Dodson & Sullivan, of Torreon, and Mora & Lopez de Lara, of Guadalajara.

THE CALIFORNIA GAS & ELECTRIC CORPORATION has closed contracts with the Stanley Electric Manufacturing Company for a number of 60,000-volt transformers, aggregating 15,000 kw in capacity. The transformers are of various sizes, the largest having a capacity of 1,250 kw, and will be installed where needed on the company's extensive system.

MERGING OF ALUMINUM PLANTS.—The plant of the Cowles Electric Smelting & Aluminum Company, on 18-Mile Creek, near Lockport, N. Y., has been sold to the Electric Smelting & Aluminum Company, of Cleveland, Ohio.

General News.

THE TELEPHONE.

SANTA MONICA, CAL.—Louis Blankenhorn, of Los Angeles, has made application to the City Trustees for a franchise to build and operate Home telephone exchanges in both Santa Monica and Ocean Park.

LOS ANGELES, CAL.—The officers and directors of the Home Telephone Company have voted to issue $500,000 worth of bonds to raise money for the completion of the system building in this city. Only $200,000 will be issued at the present time.

COLORADO CITY, COL.—The El Paso Telephone Company has been organized here with a capital of $500,000. Among those interested are M. L. Speer and Col. Robert McReynolds.

SELMA, GA.—The Maplesville & Selma Telephone Company has been organized with a capital of $4000. Telephones are to be installed at Selma and Maplesville and along the line between the two towns.

CLAYTON, GA.—The Tennessee, Georgia & South Carolina Railway Company has applied for a charter from the State of Georgia to build an electric railway from Clayton, Ga., to Chattanooga, Tenn., a distance of over 200 miles. The capital is placed at $3,000,000. Among the incorporators are W. B. Frink, J. D. Cameron and D. J. Haynes, of New York, and J. A. Jones, G. W. McAfee, E. N. Butt. William M. Wilson and others, of Blue Ridge, Ga.

CHILLICOTHE, ILL.—The People's Telephone Exchange here was destroyed by fire recently.

HOPEDALE, ILL.—The Farmers' Telephone Company has voted to increase its capital stock from $5000 to $20,000.

NORMAL, ILL.—An automatic telephone system will probably be installed here and connected with the Chicago Automatic.

PEORIA, ILL.—The Interstate Independent Telephone & Telegraph Company will erect a large new building on South Jefferson Street, this city.

SHELBYVILLE, ILL.—The Findlay Mutual Telephone Company has been organized with the following officers: President, S. D. Dole; secretary, W. R. Wallace, and treasurer, E. S. Combs.

PEORIA, ILL.—The Lee County Telephone Company has sold its exchanges and property in Ashton, Franklin Grove, Amboy, Lee Center, Walton and Sublette to the Farmers' Telephone Company. The Lee Company retains the Dixon exchange.

CLAYTON, ILL.—The controlling interest in the Siloam Telephone Company has been conveyed to B. F. Clark, of Perry Springs. The Siloam Telephone Company is the name of the corporation which is virtually the Clayton exchange and its connections.

EDINBURG, IND.—The Citizens' Telephone Company has increased its capital stock from $3000 to $9000.

VALPARAISO, IND.—The Northwestern Indiana Telephone Company has increased its capital from $15,000 to $50,000.

CHANDLER, IND.—The Chandler Telephone Company has filed articles of incorporation. The capital stock is $2500. Wm. M. Gardner, J. W. Webb and W. M. Caster are the chief promoters.

LA GRANGE, IND.—The People's Mutual Telephone Association, of La Grange County, with capital stock of $10,000, has been incorporated by John W. Evans, P. D. Porter and M. C. Miller.

GRANTSBURG, IND.—The Temple Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $5000. Joseph H. Bleonis is president and Samuel H. Miller, secretary.

CRAWFORDSVILLE, IND.—The Central Union Telephone Company is seeking to extend its arrangements with the farmers. A few years ago the company refused to make any connections with the farmers' lines.

INDIANAPOLIS, IND.—Directors of the Indianapolis Company and the New Long Distance Company have decided to expend $250,000 next year on the extension of their lines and improvements. They will spend $50,000 more before cold weather compels them to suspend operations. The company has just made a purchase of $40,000 worth of copper wire.

ANGUS, IA.—The Greene County Telephone Company will build a new line to this place.

BARNUM, IA.—The Barnum Telephone Company has been incorporated by P. T. Burk, J. W. Hagans, M. D. Gurnett and J. D. Kelley. J. W. Hagans is president and C. F. Bryant, secretary. The corporation is capitalized for $10,000.

NEW LONDON, IA.—The newly elected board of directors of the Henry County Telephone Company has elected the following officers: W. J. Francy, president; J. E. Peterson, vice-president; V. H. Shields, treasurer, and A. D. Hayes, secretary.

SPENCER, IA.—The Citizens' Telephone Company made connections with 140 rural telephones in one week. These telephones are east and south of Spencer and in making the connections the Citizens' reaches Dickens, Gillett Grove and Greenville. Arrangements are under way to reach Terril, Fostoria, Langdon, Royal, Sioux Rapids, Webb and Everly.

NORTH BRANCH, KAN.—The Farmers' Telephone Company, with $5000 capital, has been formed.

MANCHESTER, ME.—The Woodland Telephone Company has been incorporated with a capital stock of $10,000. The officers are F. S. Collins, president, and J. T. Collins, treasurer.

ORION, MICH.—The Orion Telephone Company has increased its capital stock from $1000 to $5000.

NEWTON CENTER, MICH.—The farmers of the townships of Newton and Leroy have organized a co-operative telephone company.

MARSHALL, MICH.—The Marshall Telephone Company has sold its exchange to the Citizens' Telephone Company, of Grand Rapids.

ALBION, MICH.—The Albion Common Council has voted to give an independent company a franchise to operate a telephone system in this city.

RED WING, MINN.—The People's County Telephone Company has been reorganized. F. M. White is president.

GLASGOW, MONT.—Mr. J. Moore has been granted a franchise for a telephone system.

NEOSHO, MO.—The Granby & Neosho Telephone Company has been formed with $3000 capital. Directors: R. E. Willard and others.

LIBERTY, MO.—The Missouri Independent Telephone Company has been incorporated with $10,000 capital, by S. H. Woodson, T. A. Henderson and others.

HASTINGS, NEB.—The Hastings Independent Telephone Company has been incorporated with a capital stock of $300,000. The incorporators are J. N. Lyman, H. H. Herndon, N. A. Batty, G. H. Pratt and George F. Keep.

BOSTON, N. Y.—The Boston Valley Telephone Company has been incorporated with a capital stock of $2000. The directors are Fred Frank, North Boston, and P. D. Weber and F. H. Weber, Boston.

NEW YORK, N. Y.—The New York & New Jersey Telephone Company has made a cut in its rates, averaging 20 per cent., for all places within a radius of about 40 miles of City Hall. The cut does not affect the rate for private houses.

OYSTER BAY, L. I., N. Y.—Some of the property owners of this town have begun war on the New York & Montauk Telegraph Company, lately incorporated, and which is now erecting lines on Long Island. Several poles have been cut down here. It is stated that the company is an opposition to the Western Union and that it is backed by the Postal Telegraph Company.

FARGO, N. D.—The Tri-State Telegraph & Telephone Company will construct a line from here to Grand Forks.

FARGO, N. D.—The Northern Pacific is planning to put in telephones in forty-eight stations, on the Dakota, Yellowstone, Rocky Mountain and Idaho divisions.

SHERODSVILLE, OHIO.—The Bell Telephone Company is making arrangements to install an exchange here.

MALVERN, OHIO.—The Bergholz Telephone Company has applied for a franchise at Malvern to establish an exchange.

CLEVELAND, OHIO.—The statement of the United States Telephone Company for August shows a gain of 9.6 per cent. in gross, 11 per cent. in net and 51 per cent. in surplus.

COLUMBUS, OHIO.—The Botkins Telephone Company, of Shelby County, $20,000 capital, has been incorporated by S. H. Mendenhall, Charles Eisley, T. Baughman, Mrs. Capitola Mendenhall and Josephine Miller.

HARPERSFIELD, OHIO.—The Harpersfield and the Austinburg Telephone Companies have made arrangements for connecting for free exchange. This will add Austinburg to the free exchange system of Harpersfield, Trumbull, Thompson and Hartsgrove.

COLUMBUS, OHIO.—The Columbus Citizens' Telephone Company is offering for sale $300,000 6 per cent. cumulative preferred stock the proceeds of which will be used to enlarge the plant. The new plant will have a capacity of 8000 main line telephones and an utimate capacity of 19,000 telephones.

CLEVELAND, OHIO.—It is understood that in a short time most of the subsidiary companies of the Federal Telephone Company will start the paying of dividends. All of the companies are in a position to do this with the possible exception of the Cuyahoga, which is, however, in a position to pay on its preferred stock.

CLEVELAND, OHIO.—The Common Pleas Court has refused the petition of the Cuyahoga Telephone Company to compel the Hotel Euclid to install its service. The hotel recently discontinued the service of the Cuyahoga Company for that of the Cleveland Telephone Company, and the former sought to compel the hotel to continue an alleged contract covering a period of years.

POTTSVILLE, PA.—The Mahanoy & Mahantongo Telephone Company has been granted a charter for the purpose of operating in and through the counties of Northumberland, Dauphin and Schuylkill. The capital stock of the company is $20,000. I. B. Tressler, of Mahanoy, Pa., is the treasurer of the company.

GRANITEVILLE, S. C.—The Graniteville Telephone Company has been commissioned with $3500 capital. W. A. Giles, T. H. Rennie and G. L. Knight are the incorporators.

TACOMA, WASH.—The Pacific States Telephone Company has purchased the Joseph & Elgin Telephone Company and the Farmers' Telephone Company. The latter runs from Elgin to LeGrand, Ore., and through the Grand Rone Valley.

DAYTON, WASH.—Construction of the new telephone line from this city to J. H. Romaines' ranch, about 7 miles from the city, will begin at once. J. H. Romaine, Geo. Jewett, F. C. Romaine, N. James and others are interested. The company has been named the Happy Flat Telephone Company.

CLARKSTON, WASH.—The Clarkston Independent Telephone Company has asked for a franchise to construct a telephone system in Clarkston. It is proposed to extend the line to Asotin and Anatone. Work will begin at once if it is favorably considered by the Council.

BANGOR, WIS.—The Bangor Telephone Company's exchange was burned out and the equipment damaged. A 200-drop switchboard has been ordered of the Vought-Berger Telephone Supply Company, of La Crosse, and the exchange will be rebuilt.

ELECTRIC LIGHT AND POWER.

LITTLE ROCK, ARK.—The Hazen Electric Light & Telephone Company is seeking a franchise here.

SEARCY, ARK.—Bids will be received until Nov. 1 by the Board of Public Works for constructing a power house and electric light plant complete. Owen Ford, St. Louis, Mo., is the engineer.

QUINCY, CAL.—A company is about to be incorporated, to be known as the Pacific Power Company, to operate in Plumas County. It is proposed to transmit power to San Francisco, a distance of 200 miles; capital, $1,000,000. The business office of the company will be at Minneapolis, Minn. Geo. E. Maxwell is president and Geo. P. Darling, secretary.

RIDGEFIELD, CONN.—Steps are being taken to establish an electric light plant here and subscriptions to the stock are being sought.

NORWICH, CONN.—It is proposed to install a direct-connected unit of 200-kw capacity in the municipal electric light plant of this city.

NEW CASTLE, DEL.—Jas. M. Seabury, of Philadelphia, Pa., has petitioned the Council for a franchise for water works and an electric light plant.

WASHINGTON, D. C.—Bids will be received Nov. 1 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards at Mare Island, Cal., Puget Sound, Wash., and Naval Training Station, San Francisco, Cal., a quantity of incandescent lamps, electrical supplies, etc.

HARTWELL, GA.—Bids will soon be received for an electric light plant, to cost $15,000. W. Johnson is Mayor.

COVINGTON, GA.—The Covington Chamber of Commerce will endeavor to interest foreign capital in the development of the great water powers in the southern part of Newton County, Ga.

ATLANTA, GA.—Power is now being received in this city from the Bull Sluice plant, at 22,000 volts. The energy is received at a transformer station in this city, and there reduced for railway and lighting purposes.

ST. MARIES, IDA.—Wm. McCarter has applied for permission to construct and operate an electric light plant.

CHESTER, ILL.—The Chester Light & Ice Plant has been incorporated with a capital of $10,000. The incorporators are Harvey Neville, Louis H. Gilster and A. G. Newling.

DILLSBORO, IND.—Wm. E. Swarthout has petitioned for a franchise to build and operate an electric light plant.

CRESTON, IA.—M. S. Mordant has petitioned for a franchise to construct an electric, gas and heating plant.

OTTUMWA, IA.—The Blackhawk Electric Company, of Davenport, has secured the contract for an electric light plant and wiring for the Public Water Company for about $10,000.

CHARLES CITY, IA.—A. L. Dodd is interested in the construction of an electric light plant at Charles City to cost $25,000. Bids for construction will be received about February or March next.

WICHITA, KAN.—The Citizens' Electric Light, Heat & Power Company has petitioned City Council for a franchise.

LINDSBORG, KAN.—The Commercial Club is interested in the construction of an electric light plant, to cost $12,000, and the work of soliciting has just begun. G. E. Eberhardt is secretary of the club.

BIDDEFORD, ME.—The York Light & Heat Company of this city contemplates installing a 100-hp engine and a 750-kw generator.

AUGUSTA, ME.—The Commonwealth Light & Heat Company, Augusta, Me., has been incorporated, capital $1,300. President and treasurer, I. L. Fairbanks.

BELAIR, MD.—It is stated that plans have been completed, and work will probably soon commence on the construction of the electric power plant on the Susquehanna River by the Susquehanna Electric Company. B. Harry Welch, of Philadelphia, is president.

BALTIMORE, MD.—The Baltimore Electric Power Company has been incorporated by John T. Stone, David E. Evans, president of the Maryland Telephone Company, and others, to construct a power and light plant for the Maryland Telephone Company; capital, $2,500,000.

WEST SPRINGFIELD, MASS.—Frank L. Worthy, of West Springfield, is interested in the construction of an electric light plant.

HOLYOKE, MASS.—The Electric Light Department is considering the improvement of the electric light plant, at a cost of $28,000.

NATICK, MASS.—The Edison Electric Illuminating Company has petitioned for permission to maintain lines of poles on several streets, but is meeting with opposition.

CHICOPEE, MASS.—The municipal electric light plant is making arrangements to run the plant by day as well as night, having an agreement to furnish the Burtworth Carpet Company with light, heat and power.

ADRIAN, MICH.—The Citizens' Light & Power Company contemplates the installation of a 250-hp boiler and a 200-kw three-phase generator.

KALAMAZOO, MICH.—The Kalamazoo Valley Electric Company is said to be making preparations to build a dam on Kalamazoo River in the spring.

SPRING LAKE, MICH.—The citizens have voted to construct an electric light plant. The current will be supplied by the Grand Rapids, Grand Haven & Muskegon Interurban Railway Company.

MINNESOTA LAKE, MINN.—John G. Bett, Village Recorder, writes that it is proposed to construct an electric light plant, but no plans have as yet been prepared.

UTICA, MISS.—The citizens have voted to issue $19,000 bonds for water works and an electric light plant.

AMORY, MISS.—The Amory Light & Power Company has been incorporated, with a capital of $8000, by L. B. Camp, A. C. Thompson and others.

ABERDEEN, MISS.—The City Council has ratified the purchase of the E. M. & J. K. Jones electric light plant, and the property is to be turned over to the city. The plant will probably be improved and enlarged. E. M. Jones will be superintendent and general manager.

ST. JOSEPH, MO.—The city officials have selected property at Third and Scott Streets as a site for the municipal electric light plant. The probable cost of the plant is $75,000.

OMAHA, NEB.—The Omaha Electric Light & Power Company is now installing a 1500-kw Curtis turbine unit.

KEARNEY, NEB.—The Northwestern Electric Heat & Power Company, of this city, is planning an addition to its equipment, including boilers, dynamos and transformers.

ROCKINGHAM, N. H.—The Rockingham Light & Power Company has increased its capital stock from $750,000 to $1,000,000.

LAMBERTVILLE, N. J.—The Lambertville Light & Power Company is extending its lines to New Hope, Pa., for the purpose of supplying light and power to that place.

UNION HILL, N. J.—The contract for lighting the town by electricity has been awarded to the United Electric Company of New Jersey, Hoboken, at $100 per lamp per year for 95 arc lights; incandescent light, 10 cents per kw-hour net, with a discount of 15 per cent. on all monthly bills.

BROOKLYN, N. Y.—The Edison Illuminating Company announces a reduction of 20 per cent. in the price of electric current, to take effect Jan. 1, 1905.

CLINTON, N. Y.—The citizens have voted to issue $7000 bonds for an electric light plant. Whether the present plant will be purchased or a new plant installed has not been decided.

NEW YORK CITY, N. Y.—The Tottenville Lighting Company has been incorporated for the purpose of street and commercial lighting, Capital $25,000. The incorporators are W. E. Cook, W. H. Gohagan and J. F. McCarthy, of Brooklyn, N. Y.

HOOSICK, N. Y.—The Hoosick Falls Generating Company has been incorporated, with a capital of $25,000, to furnish gas and electric light for Hoosick and Hoosick Falls. Directors: Edwin R. Case, of New York; W. Z. Roberts, of Beverly, N. J.; W. P. MacMichael, Jr., of Freehold, N. J., and C. P. Fitch, of Deal Beach, N. J.

SYRACUSE, N. Y.—At the annual meeting of the stockholders of the Syracuse Lighting Company the following officers were elected: President, Ceylon H. Lewis; vice-president and treasurer, John J. Cummings; secretary, Louis L. Waters. An order for a new battery of boilers for the electric light plant to cost $25,000 was placed.

ALBANY, N. Y.—The Central Power Manufacturing Company is reported to be negotiating for the purchase of water privileges at Cossayuna Creek, near Granville. The company is headed by Chas. R. Huntley, of Buffalo. It will maintain a plant between Schenectady and Albany, with the end in view of supplying the current for the new barge canal, besides furnishing power for manufacturing purposes.

PLATTSBURG, N. Y.—The property of the Lozier Light & Power Company has been purchased by Geo. M. Cole and T. B. Cotter, of Plattsburg, and H. L. Merry, of New York, and a new company has been formed, with T. B. Cotter as president. The contract with H. A. Lozier for lighting the streets of Plattsburg has been transferred to the new company.

FARGO, N. D.—The contract for lighting the streets and public buildings for one year has been awarded to the Union Light, Heat & Power Company, of Fargo, for $8000.

COLUMBUS, OHIO.—Bids will be received until Oct. 21 by the trustees of the sinking fund (Martin A. Gemunder, secretary), for $65,000 electric light bonds.

GRASS VALLEY, ORE.—It is proposed to enlarge the electric light and water works recently purchased. The town is in the market for a 25 or 30-hp gasoline engine, a 40-kw dynamo and a redwood tank and pump. Address the City Recorder.

HOOD RIVER, ORE.—Leslie Butler, H. F. Davidson and John Leland Henderson, a company of local capitalists, have secured a lease of ground from Dr. T. L. Eliot, and will erect a dam on the stream of Hood River, about ½ mile from the city. The water power will be utilized in operating an extensive electric plant.

YORK, PA.—The Edison Electric Light Company has, it is stated, secured the contract for lighting the city streets, 360 arc lights, for 5 years, at 13½ cents per light per night.

YORK, PA.—The Borough of Dallastown has voted to install an up-to-date system of street lighting. Arc lights will be provided for the town and the current will be furnished by the York Haven power plant.

TELFORD, PA.—A charter has been granted to the West Telford Electric Light & Power Company for supplying that borough and adjacent territory. Morris A. Clymer, of Sellersville, is one of the incorporators.

CHARLOTTETOWN, P. E. I.—The City Council of this city has called in consultation the well known firm of engineers, the DeLano Osborn Engineering Company, of Toronto and Montreal, who will fully investigate and report upon the question of a municipal electric lighting and power plant. The engineers are already at work upon the plans and estimates of a suitable plant,

AIKEN, S. C.—The Carolina Light & Power Company proposes to make considerable extensions to its equipment and system. It will probably install a steam turbine unit of about 300-kw capacity and will build ten miles of line to be operated at 5500 volts. Considerable transformer equipment will be necessary to carry out the plans that the company has laid down.

and as soon as their report is placed in the hands of the council, some decisive action will be taken.

LANCASTER, S. C.—The City Council has granted H. L. Millner, of Morgantown, N. C., a franchise for water works and an electric light plant.

LAURENS, S. C.—Bids will be received until Nov. 1 by L. G. Balle, City Clerk, for $10,000 electric light and water bonds and $30,000 sewer bonds.

LANCASTER, S. C.—The franchise recently granted to H. L. Millner, of Morgantown, N. C., for water works and an electric light plant has been transferred to Leroy Springs and T. Y. Williams, of Lancaster.

JACKSON, TENN.—The Jackson Light & Power Company has been incorporated with a capital of $25,000. Incorporators: F. B. Fisher, I. B. Tirgrett, G. S. Baird and others.

DALLAS, TEX.—The question of municipal ownership of an electric light plant is under consideration here.

EL PASO, TEX.—The International Light & Power Company contemplates installing a 150-hp turbine and a 500-kw generator.

TIMPSON, TEX.—W. M. Waterman, of Timpson, has purchased the local electric light and power plant. He will move it to his lumber mill and will install additional machinery with the view of enlarging and improving the service.

ALVARADO, TEX.—The electric light and power plant at Alvarado has been sold by A. J. McQuatters to the Alvarado Water, Light & Power Company. The new owners will move the plant to the water works pumping station and make improvements.

SAN ANGELO, TEX.—The Concho Water Power Company has completed the construction of a dam across the South Concho River, one mile south of the town of San Angelo, at a cost of $20,000, and is installing machinery at its power plant. This plant will furnish electrical energy for the San Angelo Electric Light Company and the San Angelo water works pumping station.

SALT LAKE CITY, UTAH.—The construction and equipment of a new electrical transmission station will be commenced within the next few weeks by the Utah Light & Railway Company. The plans call for a voltage of 4000.

CHEWELAH, WASH.—D. F. Strobeck, Rose Court, Spokane, writes that it is proposed to construct water works and an electric light and power plant at Chewelah, at a cost of $15,000. He further states that he will probably not contract for the work. Engineer, P. Byrn, of Spokane.

CAMERON, WIS.—There is talk here of constructing an electric light plant in connection with the water works.

VANCOUVER, B. C.—The Stave River Falls Power Company has decided to issue $900,000 bonds, the proceeds to be devoted to development. The falls are about 40 miles from New Westminster, and it is estimated that 25,000 horse-power is available.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company will build an extension to Boyles, about 5 miles.

OAKLAND, CAL.—The Oakland Traction Company is the new name under which the street railway system of Oakland will in future be operated. The owners of the Oakland Transit Consolidated have announced the formal transfer of the Webster Street franchise and a consolidation with the Webster Street & Park Railway Corporation under the new name. The Oakland Transit Company's construction department has been engaged in building an electric railway line along the Webster Street route for some time and it is nearly completed. The Oakland Traction Company has filed articles of incorporation, with a capital stock of $7,050,000. The directors elected by the Traction Company are those who composed the board of directors of the Oakland Transit Consolidated—Frank C. Havens, E. A. Heron, W. F. Kelley, S. J. Taylor, W. H. Martin, George Sterling and J. Q. Brown.

MIDDLETOWN, DEL.—The Middletown & Cecilton Railway, which is being built between Middletown and Cecilton, Md., is expected to be completed by Jan. 1. The length of the new road is 10 miles. The stockholders of the new company and those of the Middletown & Odessa Electric Railway Company are almost identical.

OCALA, FLA.—The Florida Traction Company has applied for a franchise to build an electric railway here. Robert L. Martin and his associates are interested in the enterprise.

BRAIDENTOWN, FLA.—The Manatee Light & Traction Company, John A. Graham, president and general manager, proposes to extend its lines to Oneco, in Manatee County, and to the Gulf of Mexico.

DALTON, GA.—The Tennessee, Georgia & South Carolina Railway has applied to the courts of Whitfield County, Georgia, for a charter of incorporation, with $3,000,000 capital stock. The incorporators are W. B. Frink, J. D. Cameron, E. N. Frink, D. J. Haynes, of New York City; J. A. Jones, G. W. McAfee, E. N. Butt, William M. Wilson, J. B. McKenney and Merrell Skinner, of Blue Ridge, Ga.

PADUCAH, KY.—J. J. Freundlich, C. E. Whitesides, J. J. Read, Paducah; W. H. Paul, Louisville; Byron Whitesides, New York, and others are the incorporators of the Kentucky & Ohio Interurban Company, which filed articles of incorporation. The capital stock is $25,000. This is the company that intends to build an electric railway from this city to Cairo. The company already has the right of way and will likely shortly ask the city for a franchise.

BLOOMINGTON, ILL.—The Decatur, Clinton & Bloomington Interurban Railway Company has been incorporated and the following officers elected: Harry Shlaudeman, Decatur; W. P. Carle, Wapello; Edwin Weld, Clinton; L. M. Murphy, Clinton; T. N. Leavitt, Maron; H. W. Knight, Kansas City. Bloomington will be the main headquarters and the power house will be built at Clinton.

WORCESTER, MASS.—The Worcester & Webster Street Railway Company has been granted a location in Oxford by which it will be able to connect its line with that of the Worcester & Southbridge Street Railway at Oxford Heights. Both roads are now under the control of the New York, New Haven & Hartford.

WORCESTER, MASS.—The directors of the Uxbridge & Blackstone Street Railway Company have voted to construct a line between Northbridge and Plummers Corner. This action will result in supplying the missing link and connecting the cities of Providence and Worcester with a direct line which will insure much quicker time.

MARLBORO, MASS.—The Boston & Worcester Street Railway Company is building at Marlboro a transformer station to provide more power for its Marlboro and Framingham and Hudson divisions. The transformer station is to adjoin an old power station formerly used by the Marlboro & Framingham road and still equipped for an emergency.

MAGNOLIA, MISS.—The Magnolia Electric Railway & Power Company, domiciled at Magnolia, Pike County, has been incorporated, with a capital stock of $250,000, and J. H. Price, C. V. Ratcliff and L. E. Schilling as incorporators.

ITHACA, N. Y.—The Ithaca & Cayuga Heights Railway has been incorporated with a capital stock of $50,000. The directors are J. T. Newman, C. H. Blood and C. H. Hull, all of Ithaca.

BROOKLYN, N. Y.—The work of building the municipal subway along Fulton Street has begun. This is a part of the extension of the New York subway from the Battery, Manhattan, to the Willink entrance to Prospect Park.

ITHACA, N. Y.—Bids will be received until Oct. 20 for the construction of 2 1-5 miles of electric railway at Ithaca. Bids will be received for the grading, the track work and the overhead construction separately, or for all combined. For specifications, address C. L. Crandall, engineer, Ithaca, N. Y.

ONEONTA, N. Y.—There is talk on the part of capitalists that the Oneonta, Cooperstown & Richfield Springs Electric Railway is to be extended to Catskill. The distance from Oneonta is 75 miles. With the proposed extension the road would be 130 miles in length. Herbert T. Jennings and Charles H. Tilton are the prime movers in the extension.

HIGH POINT, N. C.—The High Point Interurban Electric Railway has secured additional franchises allowing it to run its lines over the roads of Davidson County or from High Point to Thomasville or Lexington, N. C. A survey of the proposed lines must, however, be submitted to the county commissioners by whom the franchise was granted.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Railway is planning to build a new power station.

ZANESVILLE, OHIO.—H. M. Byllesby & Company, of Chicago, who control the Zanesville railway system, are reported to be negotiating with the Consolidated Company of Cambridge for the purchase of the street railway system in Cambridge and the interurban line to Byesville. There is talk that if the property is purchased a line may be built from Zanesville to Cambridge.

CLEVELAND, OHIO.—T. C. Willard, of Cleveland, has been appointed receiver for both the Cleveland & Sharon Traction Company and the Warren, Cortland & Jefferson Traction Company. C. S. Fenton, president of the first mentioned company, was the applicant in the case against the Cleveland & Sharon Company, and Francis B. Morgan, promoter of the two projects, was complainant against the other company. The actions were taken to preserve the properties against litigation which had been threatened by stockholders. Both roads are under construction by practically the same interests.

HARRISBURG, PA.—St. Mary's Street Railway Company has been incorporated with a capital stock of $42,000. Directors: H. G. Stackpole and others.

JERSEY SHORE, PA.—The Jersey Shore & Antes Fort Railway Company has organized as follows: Robert McCullough, president; J. G. Calvert, vice-president; M. T. Howell, secretary, and C. B. McCullough, treasurer.

WASHINGTON, PA.—All the rights of way have been secured for the proposed new street railway line between this place and Library by Pittsburg capitalists, headed by Senator William Flinn. It is estimated that the line will cost about $900,000.

WOONSOCKET, R. I.—It is stated that the New York, New Haven & Hartford Railroad Company is negotiating for the purchase of the Woonsocket Street Railway Company, operating in this city, North Smithfield, Blackstone and Cumberland; the Providence & Burrillville Street Railway Company, now constructing a line between this city and Providence; the Columbian Street Railway, operating in the town of Burrillville, and the Milford, Attleboro & Woonsocket Street Railway, connecting Franklin with the places named in the title.

DALLAS, TEX.—W. F. Potter, representative of the syndicate of Chicago men, which is promoting the building of an interurban electric railway from Dallas to McKinney, says that it has been determined to extend the line to Bonham. All preliminary arrangements for the construction of this road have been completed and the contract will soon be let. It will be about 100 miles long and will traverse the most populous section of the State.

SEATTLE, WASH.—Articles of incorporation of the Seattle, Everett & Skagit Electric Railway Company have been filed in the office of the County Auditor. The filing of these articles completes another step for the construction of the extensive interurban system proposed north of this city. The capital stock is placed at $2,000,000, and the officers of the corporation are W. H. Goldson, of California, president; P. J. Farley, of Seattle, vice-president and treasurer, and Edwin S. Gill, of Seattle, secretary.

HAMILTON, ONT.—Hon. Charles D. Haines, of Kinderhook, N. Y., has asked the County Council for favorable consideration of a scheme to construct an electric railway between Hamilton and Brantford.

NEW INDUSTRIAL COMPANIES.

SPIES GENERAL ELECTRIC MFG. COMPANY, New York, N. Y. has been incorporated with a capital of $25,000. The directors are P. H. Spies, S. Heyden and David E. Aarons, all of New York.

THE ELECTRIC CITY MOTOR COMPANY, Lynn, Mass., has been incorporated with a capital stock of $25,000. The officers are: President, Samuel Banton; treasurer, John H. Madden, both of Lynn, Mass.

P. M. FLETCHER COMPANY, New York, N. Y. (electrical contracting), has been incorporated with a capital of $25,000. The directors are P. M. Fletcher, J. G. Pierrez, Jessie A. Fletcher, all of New York.

GEORGE M. VALLEE ELECTRIC COMPANY, Atlantic City, N. J., (electricians, mechanical engineers, etc.) has been incorporated with a capital stock of $25,000. The incorporators are George M. Vallee, Mary F. Vallee and Oliver T. Rogers.

LEGAL.

INDEPENDENT TELEPHONY IN CINCINNATI.—Judge Littleford, of the common pleas court, has reversed the decision of the probate court which defined the manner in which independent telephone companies might use the streets of Cincinnati. The Probate court held that the independent telephone company, having a State charter, acquired franchise rights. The common pleas court sustains the contention that the Board of Council having rejected the application for the use of the streets by the telephone company, the probate court had no jurisdiction to determine the manner of using the streets. The case was that of the Queen City Telephone Company.

TELEPHONE PROTECTORS.—We are in receipt of the following from the American Electric Fuse Company of Chicago: "In your issue of Oct. 1, under legal notes a paragraph appeared relating to a patent office decision in which we are interested. The facts are not as stated in your note. As we are done an injustice by the report, which you have made, we ask that you print the decision in full and precisely as rendered. This was a decision upon an interference between Frank B. Cook and William Kaisling, involving the Kaisling and Cook protectors. We are the manufacturers of the Kaisling protector, and as such are interested. Mr. Kaisling made a motion to dissolve the interference with Cook upon two grounds: First, that no interference in fact existed between the Kaisling and Cook protectors. Second, that Cook had no right to make the claim forming the issue. The patent office decided the case in the following language: Decision on Motion: 'Motion was brought by Kaisling to dissolve the above entitled interference on the ground that no interference in fact exists, and because Cook has no right to make the claim forming the issue. Some time thereafter Cook filed exactly the same motion. No attention can be paid to Cook's motion for the reason that it was not filed in due time as provided by Rule 122. It is thought that there is no interference in fact between the two parties on the subject matter defined in the issue. Kaisling does not show any means for *restoring* the parts to normal position after the solder has softened: In Kaisling's device the parts are set in a different position after the solder has been melted so that the fuse may be removed and turned around and inserted in such a position that it will again be in operation on an excess of current. The word restoring can only mean to bring the parts back to their original position. In Cook's device this is done. The interference is therefore dissolved on this ground. The motion to dissolve on the ground that Cook has no right to make the claim of the issue is denied. The issue reads directly on Cook's device, whereas it does not read on Kaisling's device.' It will be noted that the decision rests upon the broad ground that no interference in fact exists. The minor point as to whether Cook had the right to make the claim forming the issue, was unnecessary to be considered, and was not urged by Mr. Kaisling, it being evident from the evidence that the interference would be dissolved upon the ground that there was no interference in fact. It is evident that the decision leaves the Kaisling protector absolutely free from any claims on the part of Mr. Cook. In justice to ourselves we trust that you will print this statement in an early issue."

OBITUARY.

PROF. B. S. LANPHEAR.—We regret to note the death of Prof. B. S. Lanphear, of the department of electrical engineering at the Iowa State College, Ames, Ia., on Friday, October 14. He died at his old home in Carthage, N. Y. His illness was very brief. After an attack of nervous prostration, he was taken home, with the hope of a speedy recovery, when at a distance from his work. But he was unable to recuperate. He had been at Ames for four years and was a hard worker. He was a graduate of Cornell and a member of the American Institute of Electrical Engineers. A wife and little boy mourn the loss, as do many friends, faculty associates and students.

EX-GOVERNOR CORNELL.—After a lingering illness of several months ex-Gov. Alonzo B. Cornell died at his residence in Ithaca, N. Y., on Oct. 15. All of his immediate family, with the exception of a son, Harry W. Cornell, who is in the West, were at the bedside when the end came. Mr. Cornell's illness dates back several months, when he had a stroke of apoplexy. This was followed by Bright's disease. Alonzo B. Cornell was the son of Ezra Cornell, the founder of Cornell University, and was born at Ithaca on Jan. 22, 1832. After his graduation from Ithaca Academy he became a telegraph operator, and later a telegraph manager. It was not long before he obtained controlling interest in a line of steamboats on Cayuga Lake, and from 1864 to 1869 he was cashier and vice-president of the First National Bank of Ithaca. From 1868 to 1899 he was a director of the Western Union Telegraph Company. It was in 1868 that he first became prominent in New York State politics, when he was nominated as the Republican candidate for Lieutenant Governor and defeated. The following year he was appointed surveyor of the Port of New York, an office which he held for four years. Later he was elected to the Assembly, of which he afterward became Speaker. As chairman of the Republican State Central Committee from 1870 to 1878 he was an influential political factor, and in 1880 he was nominated and elected governor. His first wife died in 1893, and a year later he married her younger sister, Miss Esther Elizabeth Covert, the daughter of George Covert, of Ithaca, a lifelong friend of Ezra Cornell. Ex-Governor Cornell was a stockholder in many railroad and mining properties.

EDUCATIONAL.

THE PRATT INSTITUTE FREE LIBRARY, Brooklyn, N. Y., has just opened to the public an applied science reference room, devoted to technical and trade literature. It is desired to make this department as useful as possible to the practical men engaged in the various trades and industries. The room contains books, bound periodicals and current periodicals, including, of course the ELECTRICAL WORLD AND ENGINEER. It is in charge of Mr. Herbert L. Cowing, a graduate of the Mechanical Engineering course of Cornell University. The room is open every day from two till six, and on Monday, Wednesday and Saturday evenings until 9:30. A cordial invitation is extended to all who are interested. The management wishes to form a collection of trade catalogues and bulletins bearing upon all branches of industry. These catalogues will be accessible to the public, and it would be glad to receive them from any of the advertisers in or readers of the ELECTRICAL WORLD AND ENGINEER.

PERSONAL.

MR. JAMES F. FAIRMAN, telephone engineer, latterly with Waterbury & Company, is now with the Ericsson Telephone Company. Mr. Fairman will look after the business end in Eastern territory.

MR. E. M. GREENE, superintendent of the electric light and power plant, Rappahannock, Va., resigned that position recently to accept the position of superintendent of the city electric light plant of Fredericksburg, Va.

MR. JAMES C. HOBART, manager of the Triumph Electric & Ice Machine Company, of Cincinnati, was a recent caller at the Chicago office of ELECTRICAL WORLD AND ENGINEER. He reports an excellent outlook for business in the electrical field.

DR. N. S. KEITH is engaged in erecting for the Pahaquarry Copper Company, the works of which are at Bangor, Pa., a large plant for the treatment of copper ores by his process, the capacity to be 200 tons per day. Bangor will be the address of Dr. Keith for some months.

PROFESSOR HARRY E. CLIFFORD has been appointed acting head of the department of electrical engineering at the Massachusetts Institute of Technology, Boston, vice Dr. Louis Duncan, resigned. The resignation of Dr. Duncan took effect October 15, when he resumed active engineering practice.

MR. LUCIUS D. GIBBS, the well-known electrical engineer, inventor and builder of practically all the electric wagons and trucks operating on the streets of New York, has joined the mechanical staff of the Manhattan Transit Company as mechanical and electrical expert. He will be associated with Mr. Charles A. Lieb, prominent also as a traction and automobile expert.

MR. WALTER C. KERR delivered to the 1904 graduating class at Stevens Institute an admirable address of advice, full of pith, wit, wisdom and ripe experience. At the suggestion of Dr. Humphreys, president of the Institute, the address has now been issued in welcome pamphlet form, in which shape it will be prized and often referred to by all fortunate enough to own a copy.

THE BROTHERS GUILLEAUME.—A cable dispatch from Berlin, of October 17, says "The Emperor has raised the two brothers Guilleaume, of Cologne, to the hereditary nobility. The Guilleaumes are largely interested in the German Atlantic Cable." As our readers know the firm of Guilleaume Brothers, or Felten & Guilleaume, is one of the largest and oldest in Europe devoted to wire and cable manufacture.

DR. GORGE NEWBERY, who was official delegate to the International Electrical Congress from the Argentine Republic, and who is general director of electrical works and public lighting for the city of Buenos Aires, has been spending some weeks after the Congress in visiting different parts of the country. He sailed for England this week, and after visiting the Continent also, will proceed directly from Europe to the River Platte.

MR. WILLIAM F. LEGGETT, who for a number of years was with the Western Electric Company of New York, and who has had large experience in electrical supply work and the publishing of circular matter and the describing of specialties and supplies, is one of the organizers in the Compiling Bureau, 56 Pine Street, New York, who are making a business of writing and publishing printed matter for electrical jobbers and manufacturers.

MR. F. A. SCHEFFLER, the well-known electrical and mechanical engineer, has resigned from the Marine Engine & Machine Company and has become the special representative of the Stirling company, with offices at 114 Liberty Street, New York City. Some years ago Mr. Scheffler was connected with the Stirling boiler interests, and was very successful; but his skill and aptitude as a manufacturer intervened to lure him away from the commercial side of engineering, to which, however, he now returns.

DR. A. PIRELLI, who is a member of the well-known cable manufacturing firm of Pirelli, of Milan, Italy, has recently sailed from New York direct for Brazil, where he will visit the rubber producing regions of the Amazon. Dr. Pirelli, who came with the Italian Electrical Association to attend the electrical congress is a young electrical engineer of much promise and made a great many friends while in this country. He will return to Italy direct from Brazil, but hopes to visit the United States again at no distant date.

MR. K. THURNAUER, of Nuernberg, is now in this country, renewing friendships made at the electrical shops at Lynn and Schenectady, ten years ago, and was a recent visitor to St. Louis. Mr. Thurnauer, who is president of the American Lava Company, of Chattanooga, has also a large lava manufacturing business in Germany. Mr. Thurnauer is a brother of Ernest Thurnauer, well known as managing director of the French Thomson-Houston Company, and formerly active under Mr. Coffin in this country as well as in Europe in the early Thomson-Houston days.

MR. HOMER E. NIESZ, of the Chicago Edison Company, has accepted the position of editor of the Question Box for the twenty-seventh convention of the National Electric Light Association and has already begun work on the same. Mr. Niesz proposes to get into communication with every central station in the country, if possible, and to reach every member of the companies interested in presenting either questions or answers. By beginning the work so early as this, Mr. Niesz will be able to sift both questions and answers thoroughly and to make a valuable selection of such as will be of greatest interest to the greatest number of managers.

PROF. A. E. DOLBEAR, of Tufts College, delivered a lecture before the Men's Club of the First Universalist Church, Newtonville, Mass., on the evening of October 10, his subject being wireless telegraphy. The lecture was illustrated by a working exhibit consisting of a large battery, induction coil, coherer, receiver and transmitter and messages were sent from one end of the hall to the other for the benefit of the audience. Prof. Dolbear devoted most of his time making clear the fundamental principles of the art of wireless communication, and toward the close of the lecture touched upon the difficulties in the way of producing non-interfering apparatus which at present confront investigators in this field. The lecture was attended by a large and interested audience, and Prof. Dolbear was freely questioned at its close.

DR. HANS GOLDSCHMIDT, of Essen-Ruhr, Germany, the distinguished inventor of the aluminothermic process, has sailed for Germany, after having attended the International Electrical Congress. On the eve of his departure a dinner was given to him on October 14 at Delmonico's by Mr. Ernest Stütz, vice-president of the Goldschmidt Thermit Company, who had invited a number of friends of the inventor and his process. The following gentlemen were among them: Mr. R. D. Benson, vice-president Tidewater Oil Co.; Dr. C. F. Chandler, Columbia University; Mr. Hy. Des Anges, superintendent floating equipment Long Island Railroad; Dr. Chas. B. Dudley, chief chemist Pennsylvania R.R. Co., Altoona, Pa.; Mr. Louis Fischer, U. S. Commercial Co., Dr. C. F. Kirchhoff, editor *Iron Age;* Mr. J. Newmark, U. S. Commercial Co.; Mr. Mason D. Pratt, consulting engineer, Harrisburg, Pa.; Mr. W. Boardman Reed, engineer maintenance and construction, New York City Railway; Dr. J. W. Richards, Lehigh University; Dr. E. F. Roeber, editor *Electrochemical Industry,* and Mr. Herbert E. Rogers, director Goldschmidt Thermit Co. Appropriate and humorous speeches were made by a number of the participants, and the flash of wit was as instantaneous as that of thermit itself.

Trade Notes.

EMPIRE WIRE COMPANY from now on will have its main office located at its factory, Rome, N. Y., discontinuing its New York City office. All communications should be addressed to Rome.

PANEL BOARDS.—The H. O. S. Engineering Company, 88 Warren Street, New York, has just issued a new panel-board circular and price-list. It gives illustrations and tabular information of the various styles of panel boards made by this company.

PUMPS.—The extensive line of pumps and hydraulic machinery manufactured by the Goulds Mfg. Company, Seneca Falls, N. Y., is completely illustrated in a 120-page booklet of recent issue. Dimensions and other information are also presented.

KEWANEE FIREBOX BOILERS.—The Kewanee Boiler Company, Kewanee, Ill., has issued a Kewanee Firebox Boiler booklet to the trade in which the good points of these boilers are clearly pointed out. The boilers referred to are designed for heating purposes.

REEVES ENGINES FOR EAST RIVER TUNNEL.—The Reeves Engine Company, Singer Building, New York, will supply six engines for the light and power plant of the East River Tunnel, New York. Three will be of 300-hp and three of 200-hp capacity, and all of the vertical cross-compound type.

SPECIAL MACHINERY.—The Garvin Machine Company, New York, in a booklet just brought out, illustrates in condensed form a line of special machinery. The object of the pamphlet is to interest manufacturers of duplicate parts, who may possibly be following ordinary general tool methods. The machines cover almost every conceivable variety of work.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland. The wide scope of the business of this concern is outlined in a handsome pamphlet of 36 pages, published under the title "What We Do." There are many illustrations showing the great variety of work produced by this company, in mechanical mining, civil and electrical engineering. The company conducts a general engineering and manufacturing business.

THE STATION EQUIPMENT COMPANY, Chicago, deals in electrical and steam apparatus which has been taken out of service as a result of consolidation, or replaced by larger units, all equipment being ready for immediate delivery. The company has just issued a pamphlet containing a list of dynamos, alternators, motors, boilers, engines, etc., that it is now offering to the trade. The list is No. 48.

THE CONNECTICUT TELEPHONE & ELECTRIC COMPANY, of Meriden, Conn., has placed upon the market five new styles of its automatic intercommunicating telephone and has issued a new bulletin describing them, which will be sent on request. The mechanical construction of these telephones is of the highest possible grade. These instruments will interest the telephone exchange as well as the electrical contractors. The company is also distributing its enlarged No. 8 catalogue which will be sent on request.

STANLEY APPARATUS.—Among the orders recently placed with the Stanley Electric Manufacturing Company through its San Francisco office are: A complete 75-kw, 2-phase generator and all auxiliaries for supplying light and power for the yards and wharves of the White Pass & Yukon Route at Skagway, Alaska; a 60-kw equipment for Crippen & Mesher, of Arlington, Wash., including a 2-phase generator, which will be used for commercial lighting in that town.

OIL FILTERS.—The excellence of the products of the Burt Manufacturing Company is evidenced by the repeated orders which it receives from the largest concerns in the county. It has recently made a shipment to the United States Steel Corporation of its oil filters and exhaust heads, which now makes 151 oil filters and 70 exhaust heads which have been supplied to this large corporation by the Burt Manufacturing Company. It has also recently sent three oil filters with automatic water separator attachments to the Penn Iron Company, Lancaster, Pa.

THE CENTRAL ELECTRIC COMPANY, Chicago, has just issued a new price list applying to its general catalogue. This price list is a very neat little book of 116 pages and is intended merely as a supplement to the general catalogue. The company is authority for the statement that a number of radical changes have been made in prices, and the book now shows the very latest market values in force, as well as lists all important new goods. All holders of the Central Electric Company's general catalogue who do not receive a copy of the new price list, should write for one.

THE KAISLING SELF-SOLDERING PROTECTOR, manufactured by the American Electric Fuse Company, has been adopted by the Merchants' Mutual Telephone Company, of Michigan City, Ind., for use with the new switchboard equipment to be installed by the Stromberg-Carlson Tel. Mfg. Company. The contract calls for 800 pairs for immediate installation. The American Electric Fuse Company especially congratulates itself upon getting this order because at the time the order was taken the customer did not have the opportunity of seeing more than a rough sketch and crude hand-made sample of the Kaisling protector.

HAMMACHER, SCHLEMMER & COMPANY, New York, have moved from their old Bowery quarters, where they had been located since 1848, to a large building at Fourth Avenue and Thirteenth Street, especially fitted up for their requirements in tools for machinists, metal workers, carpenters, wood workers and manual training schools. Their general line is shown in a catalogue of nearly 1000 pages. Special catalogues are also issued of cabinet hardware and fancy cabinet trimmings, builders' hardware, refrigerator hardware and bar trimmings. Another line that they deal in comprehensively is piano hardware, tools and materials of all kinds. They handle also electrical tools, etc.

WESTERN DISPLAY COMPANY, of St. Paul, Minn., has issued some excellent circular literature as to its electric sign business, based on the "Reflectric" sign. It is stated that in the last twelve months upwards of 200 "Reflectrics" have been placed on the circuits of the St. Paul Gas Company at an average flat rate per month of $7 for current consumption.. This gives an idea of the possibilities for local lighting companies in the sign field. The "Reflectrics" are already in use on some fifty central station systems. They are built up of interchangeable glass transparencies and interchangeable porcelainized steel panels, and are well illustrated in the loose sheet booklet sent by the company on application.

STORIES OF SUCCESS.—The International Correspondence Schools, Scranton, Pa., has just issued a pamphlet of 96 pages containing "1001 stories of success." The stories comprise a list of those who have been benefitted materially by the different courses of study taught by the schools. The list is arranged by States, alphabetically, under each State being given the names of the students therein, their places of residence and addresses, each being accompanied by a statement as to the benefits derived from the course of study. The record is a convincing one, and shows what good work is being done by these Correspondence Schools in the cause of education. The most impressive fact in this connection is the development of the latent possibilities in individuals, who might have remained in comparative ignorance and in a position unable to better themselves in a material way but for the aid of correspondence teaching. The pamphlet is well illustrated.

B. F. STURTEVANT COMPANY.—The simplicity of the handsome new office building of the B. F. Sturtevant Company, at Hyde Park, Mass., brings it into harmony with the shop buildings and still it bears the appearance of a handsome modern schoolhouse. It is about 45 feet wide and 125 feet long, with four stories and a basement. One-half of the basement is occupied by the printing plant and its stock room. Here are printed the catalogues, circulars, letter-heads and all printed forms used in the office and shops. Another portion is used as a lunch room for the office force, while the heating and ventilating apparatus is also located in the basement. Naturally the building is heated and ventilated by the Sturtevant fan system. The galvanized iron heat flues are built into the walls and convey the heated fresh air through register openings into the various rooms. On the first floor are located the production, time and cost departments and the publication department; on the second floor are the sales and accounting departments, cashier, clerks, etc., the manager's office and the filing department. The drafting rooms occupy the whole of the third floor, while the blue-print department is on the fourth floor. The fourth floor also contains two large vacant rooms which may be utilized for future growth, either as offices or drafting rooms. Eight large fire-proof vaults, each about 9 feet wide and 19 feet long give abundant room for the safe keeping of books, correspondence, drawings and valuable data. The first two floors are finished in quartered oak. The wainscoting, painting, the tinting of the walls and ceilings and the office fixtures are all very tasty and add much in making this office building one of the finest in the country.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 11, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys, 140 Nassau St., N. Y.]

771,818. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed May 28, 1904. A screen of large surface made up of conductors is mounted on a vertical axis to be turned to various angles to the incoming waves. The largest amount of energy is collected when the screen is normal to the wave travel and the receiving instrument being responsive to different amounts of energy will show when the screen is so placed and consequently the direction whence the waves come.

771,819. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed May 28, 1904. The same idea as the above, carried out with a length of wire horizontally arranged upon a pivot.

771,833 APPARATUS FOR MERCURIAL ALKALINE PROCESSES; Chas. W. Roepper, Germantown, Pa. App. filed Jan. 30, 1903.

771,820. PROTECTING DEVICE FOR HIGH-FREQUENCY APPARATUS; Lee De Forest, New York, N. Y. App. filed June 9, 1904. The circuit to be protected is connected to earth through condensers at points between diffrent apparatuses upon the circuit.

771,868. AUTOMATIC BRUSH ADJUSTER; William H. Freedman, Burlington, Vt. Means operated by the phase displacement of the current for shifting the brushes on the commutator of current-rectifying apparatus.

771,872. FURNACE FOR THE MANUFACTURE OF STEEL; Gustave Gin, Paris, France. App. filed June 30, 1903.

771,875. OVERHEAD TROLLEY WIRE SYSTEM; Coloman De Kando, Budapest, Austria-Hungary. App. filed Oct. 14, 1903. Two wires of the same polarity constituting together one conductor and attached alternately to successive points of suspension and forming alternating loops, the sagging middle parts of the loops being connected to the upwardly curving part of the adjacent loops.

771,891. PROTECTIVE SYSTEM FOR ELECTRIC CONDUCTORS; Leonard Andrews, Hastings, England. App. filed April 15, 1903. A secondary coil is mounted upon a portion of the core of a choke coil which is normally in a balanced condition by reason of equal and opposed current, flows from two feeders; the grounding of one feeder induces a current in the secondary coil which throws a switch to cut out the grounded feeder.

771,902. MACHINE FOR WINDING COILS; John J. Frank, Schenectady, N. Y. App. filed June 21, 1901. A segmental mandril equipped with means for expanding and contracting it and with movable gages and collars facilitating the winding of magnet coils.

771,907. ELECTRIC ARC LAMP; Charles E. Harthan, Lynn, Mass. App. filed March 11, 1902. Details of construction with reference to the frame, the negative carbon holders, the automatic pick-up and the support for the inner globe.

771,908. ELECTRIC HEATER; Harry E. Heath, Windsor, Conn. App. filed Feb. 12, 1904. The heating devices are inclosed within a chamber provided with openings on different levels to create a draft of hot air and a secondary chamber arranged at the discharge end and with feed openings for an induced flow of cooler air.

771,916. LAMP RECEPTACLE; Andrew A. Moffitt, Pawtucket, R. I. App. filed Nov. 14, 1903. The receptacle has a side and center contact arranged at considerably separated levels to avoid short-circuits by the collection of water in the bottom of the receptacle.

771,917. WAVE TRANSMITTER; Roberto L. De Moura, New York, N. Y. App. filed Feb. 9, 1903. The primary circuit of the induction coil of a wireless transmission system is interrupted by means of sonorous vibrations.

771,932. ALTERNATING CURRENT METER; William H. Pratt, Lynn, Mass. App. filed March 3, 1903. A certain relative arrangement of the cores of the potential and current coils.

771,958. CONTROLLER; Montraville M. Wood and Henry Geisenhoner, Schenectady, N. Y. App. filed April 4, 1904. A magnetic clutch holds a rheostat arm at any position on its line of contact and will release whenever the current drops below the normal.

771,968 ELECTROSTATIC INSTRUMENT; Francis H. Bowman, Lynn, Mass. App. filed Nov. 25, 1903. Auxiliary conducting surfaces can be mounted or removed at will in relation to the pivoted vane to adapted the instrument for use on circuits differing widely in potential.

771,983. INSULATED JOINT; Percy Holbrook, New York, N. Y. App. filed Dec. 28, 1903. This invention relates to the detailed arrangements of layers and washers of insulating material interposed between the rail chairs and rail and between the fish plates and rail.

771,987. ELECTRIC CRANE; Harry A. Lewis, Norristown, Pa. App. filed Dec. 30, 1903. At the limit of motion of the crane, a branch circuit is established whereby the motor is arrested but is left ready to start in the opposite direction in response to the proper positioning of its controller.

771,988. INCANDESCENT ELECTRIC LAMP; Jesse R. Lovejoy, Schenectady, N. Y. App. filed Dec. 11, 1901. A two-filament lamp having a socket by means of which the circuit can be changed from one filament to another by twisting the lamp in case one of the filaments is destroyed.

771,989. ELECTRIC SWITCH; Frederick Mackintosh, Schenectady, N. Y. App. filed Oct. 19, 1897. The switch blade is pivoted on one side of a plate of non-conducting material and connected by gear segments with a lever pivoted on the opposite side of the plate, thereby protecting the operator who throws the switch from injury by the arc.

772,002. ELECTRIC CLOCK; Theodore A. Schleuter, Oakland, Cal. App. filed Feb. 7, 1903. Details.

772,008. INSULATED JOINT FOR RAILROAD RAIL SECTIONS; George A Weber, Stamford, Conn. App. filed June 4, 1901. This invention and those following in the same name relate to special arrangements of insulating material between the abutting ends of the rails, the rail chairs and rails, and the fish-plates and rails.

772,009. INSULATED JOINT FOR RAILROAD RAIL SECTIONS; George A Weber, Stamford, Conn. App. filed June 4, 1901. See patent 772,008.

772,010. INSULATED RAIL JOINT; George A. Weber, New York, N. Y. App. filed Nov. 23, 1903. See patent 772,008.

772,011. INSULATED RAIL JOINT; George A. Weber, New York, N. Y. App. filed Nov. 24, 1903. See patent 772,008.

772,051. INDICATOR FOR ELECTRIC SNAP SWITCHES; Charles G. Perkins, Hartford, Conn. App. filed Oct. 15, 1903. The "Off" and "On" marks on a switch to indicate the condition of the circuit, are printed on the ends of the rotary handle and show the condition of the circuit when the words are opposite an index on the case.

772,063. GLOVE FORMER; George J. Schneider, Detroit, Mich. App. filed Nov. 19, 1903. The glove former is electrically heated by an internal resistance.

772,066. AUTOMATIC SWITCH; Charley H. Stanley, Rorrer, Va. App. filed April 16, 1904. Details of a mechanism for electro-magnetically throwing a switch tongue in the track from the car platform.

772,067. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed July 20, 1904. A dash-pot controls the movements of the controller handle and is itself controlled by a bi-pass operated at different positions of the controller handle.

772,083. ELECTRIC MOTOR; Edward Bretch, St. Louis, Mo. App. filed May 11, 1903. Details of a centrifugal switch for short-circuiting the armature when the speed reaches a proper degree.

772,086. ELECTRIC ELEVATOR APPARATUS; Eugene R. Carichoff, East Orange, N. J. App. filed July 29, 1903. A dash-pot is arranged in connection with the controller handle in the elevator car to prevent the car from being retarded too suddenly; the invention likewise includes means controlled by the speed of the motor for preventing the full application of the brake.

772,087. TROLLEY; Henry B. Clarke, Chicago, Ill. App. filed Nov. 9, 1903. A restoring wheel is positioned alongside of the trolley and a movable guard is positioned alongside the restoring wheel and provided with an inwardly-inclined guiding periphery.

772,096. SYSTEM OF ELECTRICAL DISTRIBUTION; Josef H. Hallberg, New York, N. Y. App. filed Oct. 26, 1903. A regulator for alternating series arc light systems embodying means for automatically varying the induced current without altering the number of active coils of the secondary of the transformer and the impedence in the distributing circuit.

772,102. ELECTROPLATING APPARATUS; Willis R. King, New York, N. Y. App. filed Feb. 8, 1904.

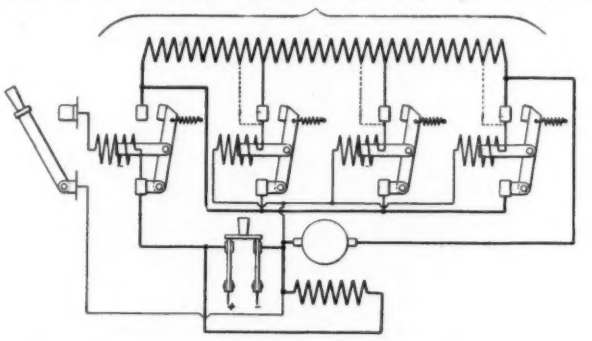
772,107. RAIL JOINT; Monroe D. Leebow, Sheridan, Pa. App. filed Aug. 6, 1904. Details.

772,123. LEAD CONTAINING CELL FOR SECONDARY BATTERIES; Vincent G. Apple, Dayton, Ohio. App. filed June 3, 1903.

772,172. RAIL BOND; William E. Oakley, Millbury, Mass. App. filed Jan. 2, 1903. The steel end of a flexible copper bond is cast around the bond so as to be intimately connected with it.

772,188. RAIL BOND; Edward G. Thomas, Waltham, Mass. App. filed March 26, 1903. A mounting for a laminated rail-bond.

772,189. METHOD OF ATTACHING RAIL BONDS TO RAILS; Edward G. Thomas, Waltham, Mass. App. filed March 19, 1903. For soldering a bond to the under side of the rail base, a metal plate is interposed between the end of the bonds and the rail and the parts bolted together, the edge of the plate extending outward and turned up to receive solder.



772,277.—Current Controlling System.

772,190. LIGHTNING ARRESTER; Percy H. Thomas, Pitsburg, Pa. App. filed Feb. 6, 1903. A bunched set of discharge terminals placed in a group and serving to protect apparatus on different circuits.

772,200. DEVICE FOR REPLACING FUSES; Herbert G. Addie, Cresco, Iowa. App. filed April 4, 1904. A magazine of fuses is arranged in juxtaposition to a set of clips adapted to receive the fuses successively and a plunger with a handle is operated to force the fuses one by one into the clips.

772,257. ELECTRIC ARC LAMP; Ralph Scott, Wilkesbarre, Pa. App. filed Oct. 14, 1903. Details.

772,277. CURRENT CONTROLLING SYSTEM; Arthur G. Eastwood, Cleveland, Ohio. App. filed June 4, 1904. A system for controlling the flow of current by which it is possible to use a number of electro-magnetic switches of similar construction and adjustment to successively short circuit portions of resistance in order to accelerate the speed of the motor.

772,278. ELECTRIC AUTOMATIC BLOCK SIGNAL AND SAFETY SYSTEM; George P. Finnigan, Greene, N. Y. App. filed May 1, 1902. Details.

772,288. VENTILATED COIL FOR ELECTRICAL APPARATUS; Newitt J. Neall, Edgewood Park, Pa. App. filed Jan. 20, 1904. Non-conducting material arranged to form diagonal ventilating passages is interposed at various places in the coil between the layers.

772,291. AUTOMATIC CIRCUIT CLOSER; Hermann H. Pape, New York. N. Y. App. filed May 17, 1904. In the handle of a telephone receiver a weight is loosely disposed and acts upon a pair of contact springs to close the circuit when the receiver is held upright and to open the circuit when it is reversed.

772,298. TROLLEY WIRE SUPPORT; William H. Spiller, Aurora, Ill. App. filed Feb. 2, 1904. Details of a clip.

772,313. ELECTRIC CONTROLLER; Arthur W. Harrison, Los Angeles, Cal. App. filed Aug. 24, 1903. The brushes are arranged so that they are moved away from and toward the controller contacts, making it possible to place the contacts closer together.

772,321. TROLLEY; Perry Anderson, Sharpsburg, Pa. App. filed June 20, 1904. A disc arranged beside the trolley wheel, carries an overreaching lug which holds the wheel on the wire, but is itself held in place by a spring so that it may yield laterally and release the wire.

772,322. FEEDER PROTECTION; Leonard Andrews, Manchester, England. App. filed Nov. 6, 1903. An electro-magnetic device is operative upon the unbalancing of current flow in a differential choke coil, which connects the parallel feeders; the electro-magnetic device operates a switch in the circuit of one of the feeders.

12,273. ELECTRIC CIRCUIT CLOSER AND BREAKER; Thomas H. McQuown, Biggsville, Ill. App. filed July 7, 1904. A rotary member adapted to close a circuit once during each rotation and means whereby the period during which the circuit remains closed is independent of the speed of rotation.

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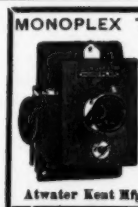

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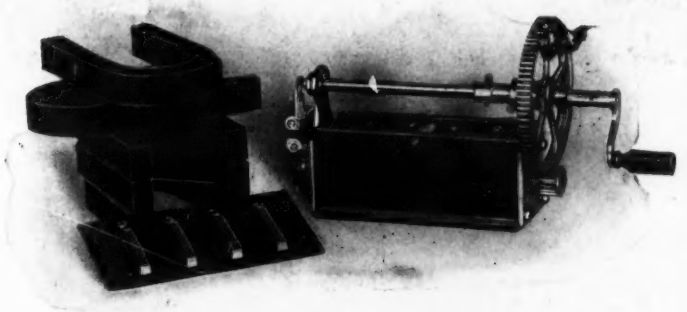

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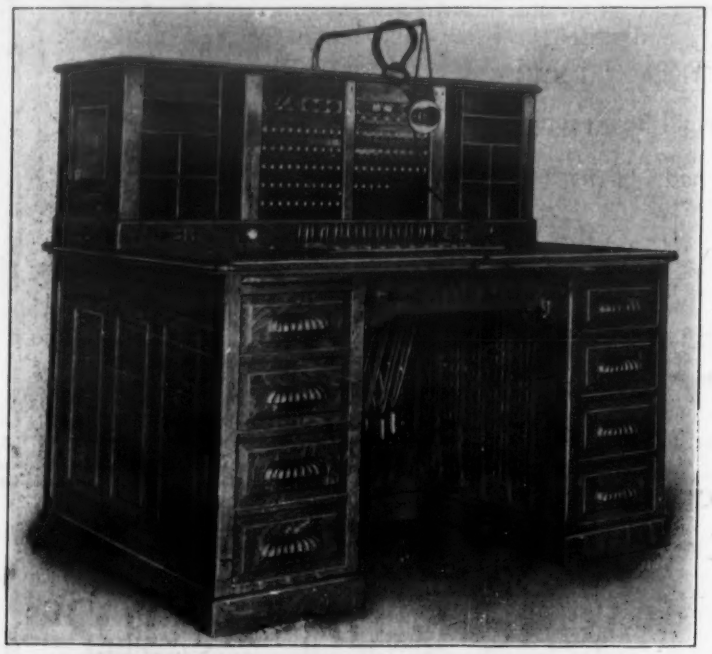

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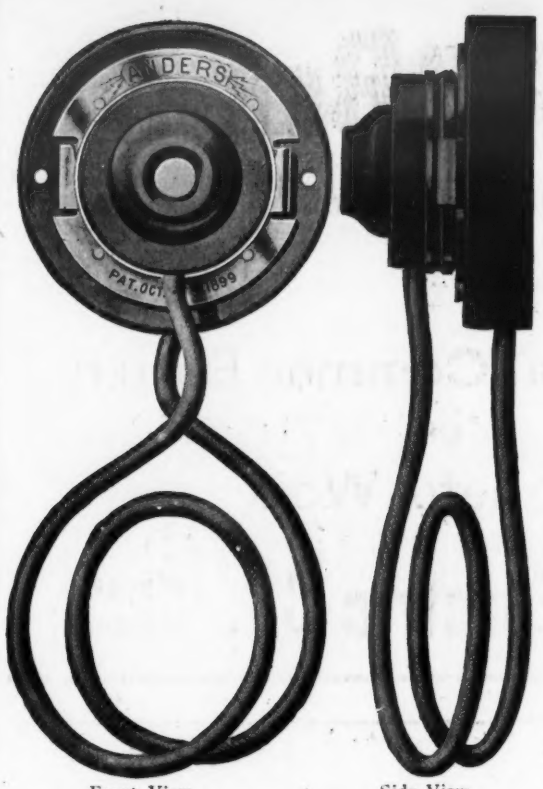

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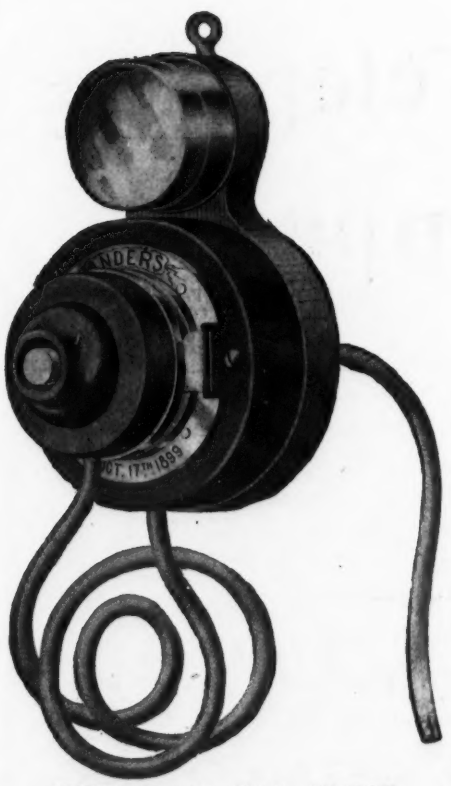

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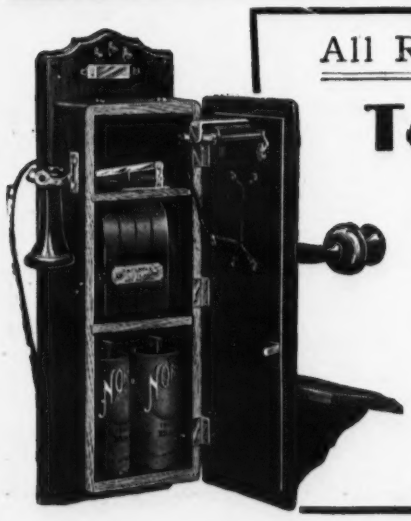

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